PUBLIC WORKS

City, County and State

Photo Courtesy Austin Western Road Machinery Co.

Washington State Highway Department forces working on the Susqualmie Pass road in the Cascade Mountains. This road is typical of the modern highways that have opened to the traveling public the many marvelously beautiful areas of the West.

AUGUST, 1936

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DUMP WAGONS	ROAD-MIX MACHINES	SNOW PLOWS
DUMP CARS	CULVERTS	

PUBLIC WORKS

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TIMEWASTERS

Prologue:

A difference of opinion on that problem of Mr. Anderson's about a box to hold a 3-inch ball and a 1-inch ball. The original answer sent in with his problem called for a box 3 by 3 by 3.414 in., with a cubical content of 30.726 inches. This answer is checked by Mr. Childress of Indiana; on the other hand, such sharks as Mr. Wheeler of N. H., and Mr. Blunk of Indiana differ, one of them having slightly more for the off dimension, and the other slightly less.

Trouble:

And trouble for the editor of this column. Mr. Coggeshall from S. C., hops on him for the inexcusably careless use of the word "fowling piece." We, having practically cut our teeth on a gun barrel, knew that one doesn't use such a firearm for target work; Mr. Coggeshall being, we suspect, one of those mountain Coggeshalls—or at least kin to them—probably cut his teeth on a hog-rifle, too. Well, in accordance with our promise, he gets one honorary membership in the Order of the Boar.

More Marbles:

Says Mr. Wheeler, "What is the diameter of a marble that can be enclosed in a cubical box having a 3-inch edge, provided the box already contains a ball having a 3-inch diameter?"

More Numbers:

There are four combinations of numbers which, when multiplied by "7" give in the multiplier, the multiplicand and the product all of the ten digits. What are they? See the June issue for a somewhat similar problem and the July issue for an answer.

The Taxicab Problem:

Two gentlemen attending the Water Works convention in Los Angeles, though good friends, were quartered in different hotels. Mr. A was in Hotel X, while Mr. B. was in Hotel Y, which was approximately half the distance between Hotel X and Hollywood. Deciding to investigate the charm and appeal of that gay glittering city, Mr. A starts out in a taxi, stops at Hotel Y and picks up friend B. After giving Hollywood the once over, the friends return, B dropping off at Hotel Y, and A continuing on to his hotel. The taxi fare was $2.80. The next morning, B offers to pay his share of the taxi fare, but they cannot agree on how much this share would be. Can Timewaster addicts help them out? W. A. H.

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A. PRESCOTT FOLWELL, Editor — **W. A. HARDENBERGH,** Asso. Editor

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FOUNDED IN 1896

TEN DAYS *then*

A ROAD LIKE THIS!

Calcium-Chloride-stabilized section of Ohio State Route 35, between the cities of Chillicothe and Washington Court House.

WITH STABILIZATION

WE MIGHT go on from now 'til doomsday, extolling the merits of stabilization but, after all, the proof is in the pudding. That's why we want to tell you an experience of the Ohio State Highway Department, as reported by T. E. Morgan, Assistant Division Engineer.

Last fall, after a newly-built gravel road lacked support value and was rejected by traffic, it was decided to stabilize the section. To use Mr. Morgan's words:

"We started immediately and ten days later the four-mile section was completed and opened to traffic with a six-inch compacted 'clay concrete' slab of coarse and fine aggregate and clay cement, with calcium chloride as the chemical aid to stability. The section is still open to traffic, in excellent condition and carrying an average of 1500 cars daily, of which a considerable percentage consists of heavy coal trucks on long hauls.

". . . there must be something to a theory that will provide for converting a road, thoroughly objectionable to traffic, into one entirely satisfactory to traffic, from the standpoint of support value, in the short period of ten days. Moreover, more aggregate was incorporated in that section in proper proportions in the ten-day period than could be incorporated in improper proportions in ten years by the traffic bound method, to say nothing of the wasting away of aggregate and the additional aggregate required from year to year, with its incidental maintenance costs."

Road officials everywhere are having similar experiences with calcium-chloride-stabilization. Write today for technical bulletins and complete information on how to build and maintain low-cost, all-weather stabilized roads.

Calcium Chloride Association

The Dow Chemical Company, Midland, Mich.
Solvay Sales Corporation, 40 Rector St., New York City
The Columbia Alkali Corporation, Barberton, Ohio
Michigan Alkali Company, 60 E. 42nd St., New York City

CALCIUM CHLORIDE

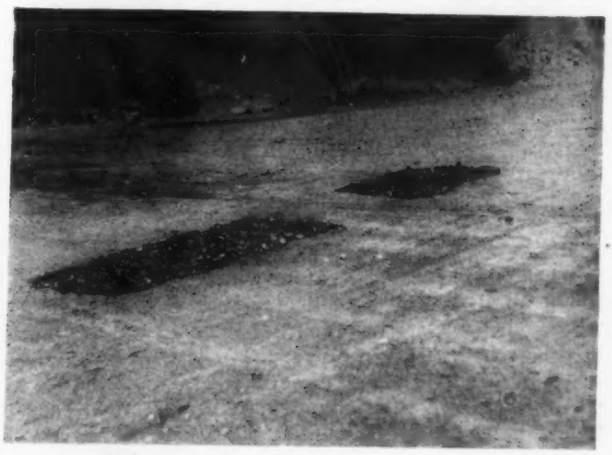
FOR STABILIZING ROAD SURFACES

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 51-53.

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 67 — *August, 1936* — No. 8



All holes in the highway should be patched before winter sets in. Detail directions are given in this article for making patches.

Getting Roads Ready for Winter

By GEO. E. MARTIN*

THE road official and other highwaymen, busy with their summer construction program may think that winter is far away but it will be here before we know it. Two things should be kept in mind in making preparations to carry roads and streets into the winter. One is to reduce, as much as possible, the hazards of winter driving. The other is to protect the road surfaces from the effects of excessive moisture, low temperature, and alternate freezing and thawing.

Patching and Drainage

Roads will be safer for cold weather car operation if they can be kept free from ice. This means that depressions in the road where water may be held should be filled and the surface shaped so that the water will be shed to the drainage outlets. A tar cold patching mix is most satisfactory for this purpose. It may be made of cut-back tar and aggregate mixed by the user or may be purchased ready mixed from a central mixing plant. It is not too early now to look over the highway surfaces after a rain and locate and record the spots where water collects and stands.

Side ditches, catch basins, drains and culverts should be examined in the late fall and cleaned if necessary. It does little good to prepare the roadway to shed water if the outlet for the water is not free and open. A partially filled culvert is quite likely to clog during the winter and cause serious difficulty.

Preventing Skidding

Sanding icy grades is a service much appreciated by the motorist. Either sand or cinders may be used. The amount should be kept as low as possible consistent with producing a safe driving surface. This not only reduces the cost of the work but also prevents needless abrasion of the pavement as the ice melts. Calcium chloride scattered over the roadside storage piles at the rate of about 100 pounds per cubic yard will keep the sand or cinders in a more workable condition in cold weather. It will also assist materially in causing the aggregate particles to become imbedded into the icy road. If the aggregate and calcium chloride are thoroughly mixed in a mechanical mixer, the amount of the salt may be reduced to approximately fifty pounds per cubic yard since the aggregate particles are more uniformly covered. This procedure also prevents undue concentration of the calcium chloride solution.

Shoulder Treatment

The shoulders of all surfaced roads should be inspected and repaired in the late fall. If the shoulders are higher than the traveled way they should be graded off so that the water can get to the side ditches. On the other hand, the shoulders are often low at the edge of hard surface pavements. These low spots should be filled so that they will not hold water and also to prevent a dangerous rut at the edge of the pavement. Shoulders of gravel or stone may be water-proofed with an application of cold refined tar at the rate of about one-third gallon per square yard. A tar with an Engler specific viscosity of 13 to 18 at 40°C is quite satisfactory for this purpose. A light sand covering should be used. Work of this kind can be done in October and,

*Consulting Engineer, The Barrett Company, General Tarvia Department.

under favorable conditions, in November. Such a treatment will prevent surface water from going down under the edge of the pavement and also will strengthen the shoulder for supporting such traffic as may come upon it. One eastern state has treated shoulders along practically all of its concrete roads.

Patching and Sealing

Patches made during the summer should be inspected in the fall and if they show an open surface they should be sealed before going into the winter. Many patching mixtures are not well graded and disintegrate if they are not sealed to prevent water entering and freezing within them. Either a cut-back tar or a cold refined surface treatment tar can be used for this purpose. A light cover of coarse sand, fine gravel, or slag, or small sized stone chips will be needed. Even patches on roads which are to be surface treated should be sealed ahead of the treatment if they are at all open. This prevents the tar in the surface treatment from going down into the patch. Sealed patches will be concealed by the surface treatment.

Needless to say all holes in the highway or street surfaces should be patched before winter sets in. A neglected small hole in the fall may be a very large hole before spring. Care in preparing the hole and in making the patch will be well repaid. The hole should be thoroughly cleaned and the edges cut approximately vertical. Painting the edges with liquid tar cut-back before the hole is filled with cold patch will seal the edge of the hole. It is better to under-fill rather than over-fill the hole, since a slight depression is less objectionable than a bump. The seal coat will bring the patch up to grade. The patches should be consolidated with a roller if possible. Just throwing the cold patch into the holes without any preliminary preparation places an undue burden on the cold patch material. A large proportion of such patches will be lost during the winter, although adequate sealing will do wonders in reducing this loss.

Crack and Joint Filling

The fall is an excellent time to fill the cracks and joints in concrete roads and streets. The concrete has contracted and the cracks are more open than in the summer. There is the additional advantage of sealing these openings just before winter sets in. A tar having a float test at 50°C of 100 to 160 seconds is used for this purpose. It is heated to about 250°F and poured into the cracks and joints. A sand is generally used to prevent picking up by traffic.

For filling wide cracks and joints a plastic tar mixture applied cold has been used for several years. This plastic tar is shipped in metal drums. A plate carrying a pump and a hose fits into the top of the drum and is held in place by clamps. A hand crank furnishes the power to force the tar, under pressure, through a hose and nozzle into the crack or joint. This material will remain in the pavement and close the opening for several years.

Re-tread Treatment

Re-tread is now designed with two seal coats. The final one may often be delayed until fall but should usually be applied then in order properly to carry the pavement into the winter. In a similar manner the seal coat is often omitted on gravel mulch treatments done during the summer. If the surface is at all open when the road is inspected in October, a light tar seal coat should be applied. This may run as low as an eighth of a gallon square per yard although twice that will often be needed. Generally the same grade of tar as was used in the mixing will be used for the seal coat.

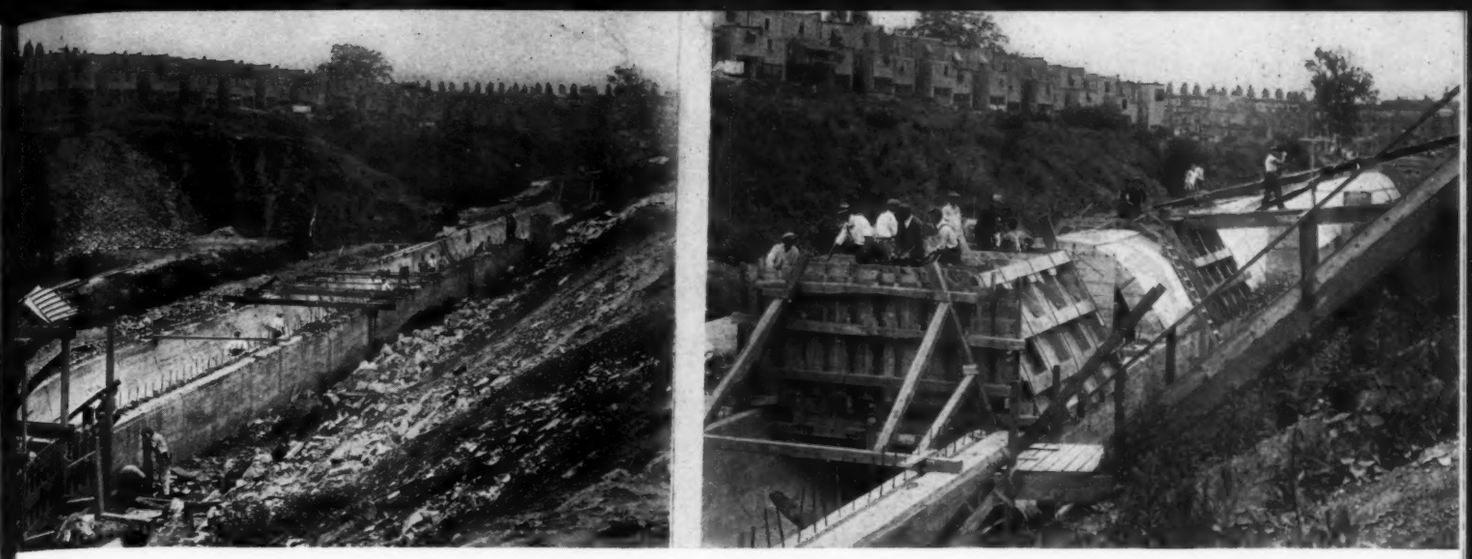
All treated and pavement surfaces should be inspected in the fall to see that they are well sealed before being subjected to winter conditions. A late fall tar seal coat has saved many a road that would have been seriously damaged before the next summer. Both cold and hot surface treatment tars are used for this purpose. It may be sufficient in some cases to seal only a portion of the surface. One street superintendent, whose residence streets are practically all tar treated gravel, spends about a week each October with a tar truck and a hose, spot sealing the places he considers weak. As a result he never has any serious breaks in the spring even though his streets cost only a small fraction of the cost of the usual city pavements.

Right now is the time to plan what is to be done in October and November, and those are the months when the most effective work can be done in preparing the road surfaces for the ravages of winter.

Glass for Road Surfacings

Ten years of experiments by a London inventor have resulted in a glass material for surfacing roads. Glass is the hardest synthetic material obtainable and, unlike tar, cement or wood, is little affected by weather conditions, grease or oil. The product is made from broken waste glass, melted and molded under high pressure. It is laid in small triangular forms that can be easily removed for repairs beneath the surface of the road.—*Glass Digest.*

At the left is shown a tar treated gravel shoulder along a concrete highway; in the center, a distributor is placing bitumen for a seal coat; at the right, these men are filling cracks and joints with plastic Tarvia X.



View of the construction of the 12-ft. storm sewer in Upper Darby Township.

Building a 12-Foot Storm Sewer with W. P. A. Labor

By WILLIAM W. REEDER

Assistant Engineer, Bureau of Public Works, Upper Darby Township, Pa.

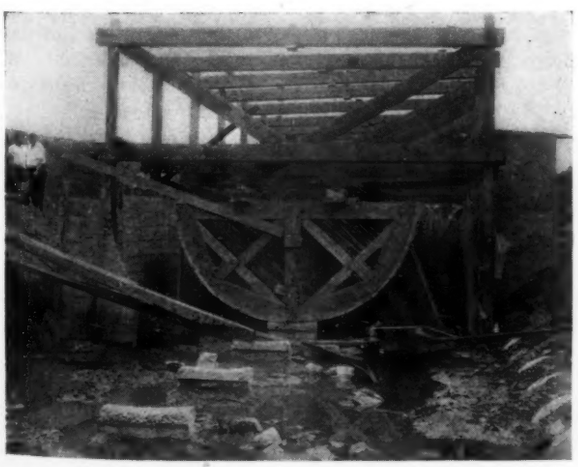
FOR a distance of 1600 ft., Naylor's Run in Upper Darby Township, Pennsylvania, lay directly in the bed of a proposed through traffic artery. Several years ago a double box-culvert was designed to enclose this stream, contractor's bids for which ranged from $165,000 to $210,000. For a number of reasons construction was not carried out at that time, but with the advent of "W. P. A." it was decided to apply for federal aid to complete the project.

The stream has a drainage area of 4.25 square miles, with an estimated total run-off of 1912.5 cubic feet per second. The available gradient was .0077. Having in mind the type of labor furnished for such work (and incidentally to reduce the necessary cross section by cutting down the wetted perimeter) a twelve foot circular section was designed. This plan simplified the work; reduced the amount of forms required, and did away with steel reinforcement.

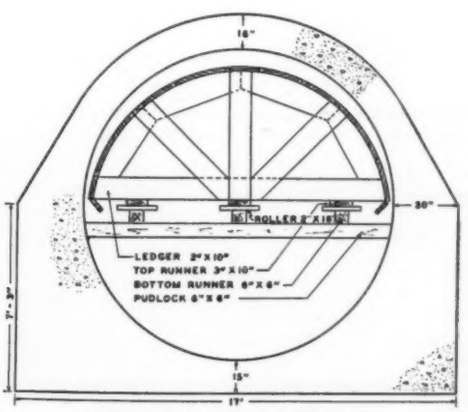
As the construction of the culvert alone required 5,950 cubic yards of concrete, it was decided to use pre-mixed material delivered to the operation in agitating trucks. This was found most satisfactory, as much as two hundred cubic yards being poured in one day.

For the bottom segment a 1:2:4 mix was used with 1½-inch coarse aggregate. To secure proper flow in the chutes a six-inch slump was necessary. A series of compression tests demonstrated that a 1:2:3 mix developed a strength of 2,450 pounds in seven days, compared with a strength of 2,370 pounds in twenty-eight days for a 1:2:4 mix. For this reason a 1:2:3 mix was used in the top segment, using a ¾-inch coarse aggregate, and the inside forms were moved every five days.

The principal problem in pouring the bottom segment was to prevent the great mass of concrete from floating the inside forms. This was overcome by a series of 3″ x 10″ diagonal braces which developed a "scissors"



Forms in place ready to pour bottom segment.



TOP FORMS DROPPED
ON ROLLERS
IN POSITION TO SHIFT FORWARD

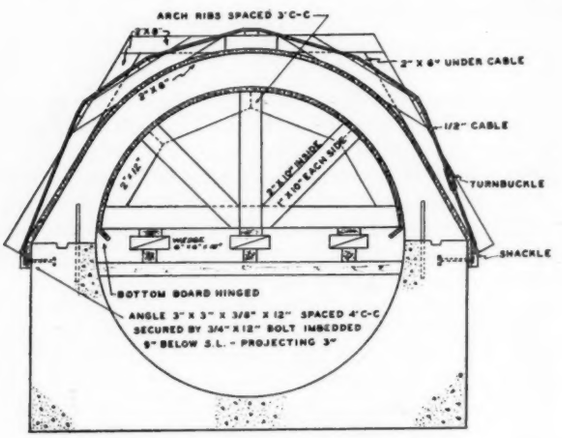
action under pressure. These braces are shown in the accompanying sketch.

About fifteen per cent of stone, from one-half to one cubic foot each, was added during the placing of the concrete, taking care to keep each stone at least six inches from the forms. As this stone was purchased at eighty cents per ton, a considerable saving was effected by its use. Form setting was simplified by placing precast blocks to grade along the center line as a support for the inside forms.

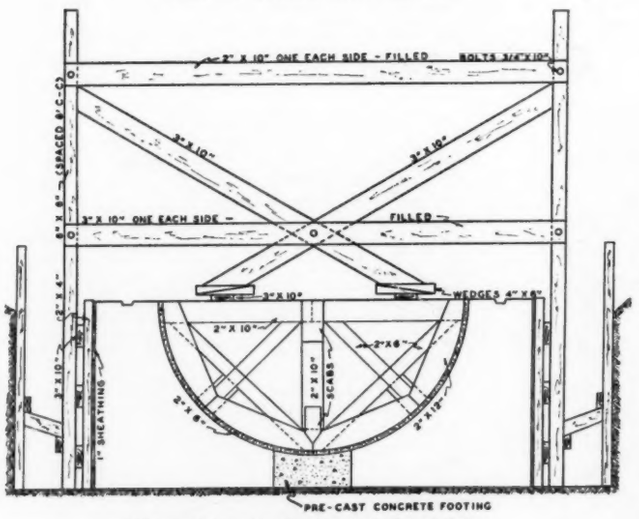
Bolts, ¾" x 12" and spaced four feet apart, were embedded in the concrete nine inches below the springing line and projecting three inches outside of the structure. Angle irons attached to these bolts supported the outside top forms. To these bolts were also fastened the half-inch steel cables which passed over the forms, and, tightened by turnbuckles, kept the forms in place.

The inside top form was so constructed that when wedges were removed the forms dropped onto rollers ready to be moved to the next location. Bottom forms were built in eight-foot sections; from six to ten sections being placed together for each pouring. Top forms were in sixteen-foot sections; two sections being poured at one time.

A fill of from three to twenty feet was required over the culvert. As this fill would take considerable time to fully settle, a bituminous macadam paving was designed for this portion of the road, with the idea of repaving with concrete at a latter date. Beyond the culvert construction, where a solid subgrade existed, an eight-inch reinforced concrete paving was used.


ARCH RIBS SPACED 3'-0" C-C
2" X 6" UNDER CABLE
1/2" CABLE
TURNBUCKLE
SHACKLE
BOTTOM BOARD HINGED
ANGLE 3" X 3" X 3/8" X 12" SPACED 4'-0" C-C
SECURED BY 3/4" X 12" BOLT IMBEDDED
9" BELOW S.L. - PROJECTING 3"

TOP FORMS IN PLACE



BOTTOM FORMS IN PLACE

Compare this drawing of bottom forms in place with photo at bottom of preceding page.

In addition to the culvert, the project included 1,900 lineal feet of 30" sanitary outfall sewer, 15,000 square yards of concrete highway paving, 5,800 square yards of macadam paving, and 6,000 lineal feet of concrete curbing.

As sponsor of the project, Upper Darby Township's contribution was $77,133.55. The W. P. A. allotment was $132,450.00, of which $14,155.00 was for material.

A. F. Damon, Jr., is Township Engineer of Upper Darby, Pennsylvania.

California Cooperative Snow Surveys

At the end of March and early in April snow surveys were made at most of the established snow courses throughout the Sierra Nevada. One hundred fifty courses were surveyed by the State and other agencies cooperating with the State on this work. The 5 not measured were at high elevations, mostly above 10,000 feet, where during the measuring period, treacherous storms prevailed, making traveling conditions in these isolated areas so hazardous that it was considered inadvisable to dispatch men to make the surveys.

Most of the measurements showed that on April 1st this year's snow pack, from the standpoint of water content, is superior to that of any year since 1932, while at quite a few places the 1932 snow pack is exceeded. This water content of the snow pack as of April 1st, is in general indicative of the spring run off to be expected in all of the snow fed streams of the Sierra.

Using the data furnished by the snow surveys, supplemented by rainfall figures from all mountain precipitation stations, forecasts of April-July run off and also of seasonal (October-September) stream flow for the year 1935-1936 were prepared. An analysis of the forecasts indicate that the water year 1935-1936 approaches very nearly the 1890-1929, 40 year mean and is the best this State as a whole has experienced since 1927.

New Waterworks for Julesburg, Colo.

The outstanding accomplishment for the year was the building of a new water works system for the town, costing $70,000, according to Mayor W. E. Law, in his report before the Colorado Municipal League.

"This is a 3½-mile, 12-inch cast iron pipe line connecting with our present city mains. Water is supplied from two wells 80 feet deep. Water is supplied to the mains by two Pomona pumps, one having a capacity of 400 G.P.M. and the other 600 G.P.M. They are driven by 15 and 25 H.P. motors, direct connected.

The pumps were designed for 130 feet head in case we wish to pump directly into the mains in place of using the 60-foot standpipe which is located close to the pumps.

Water is delivered from the 141,000-gallon standpipe through the mains by gravity to a 100,000 gallon elevated tank in town, which in turn supplies a 200,000 gallon tank for the U. P. R. R.

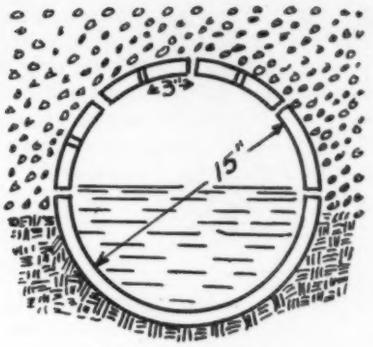
This was not a WPA or PWA set-up. The town floated $50,000 in bonds to cover the cost. The principal object of the project was to provide soft water for the town.

Other advantages are: That the pumping cost has been reduced by one-half and that we have additional storage capacity for fire protection."

A Water Supply from a Filter Gallery

By W. D. STALKER

Mgr., Public Utilities Commission, Simcoe, Ont.



The filter gallery

IN SIMCOE, Ont., water is obtained by means of a filter gallery located about one-half mile west of the town itself, the site selected for this purpose being a flat area of land lying between a rather low hill on the south and a small stream known as Kent's Creek on the north. Before making a decision on this supply, considerable exploratory work was carried out by sinking test holes along the banks of Kent's Creek, which flows through a considerable natural drainage area. Just downstream from the site finally selected, a hard-pan or shale formation running approximately north and south was encountered, which appears to hold back to some extent the ground water in the area immediately above, causing a rise in the ground water level. This was the final factor in deciding upon the location of the water supply works.

At the time of the original construction, the area selected for the site of the filter galleries was fairly well covered with a substantial stand of cedar trees, and an actual purchase of the land was not made, the owner simply granting a lease for a dollar per year. Subsequently, however, the tree growth was cut off and as the land was being used for pasturage, an irregular shaped plot of four acres containing the galleries was purchased and fenced. The ground in the enclosed area has since become quite well sodded.

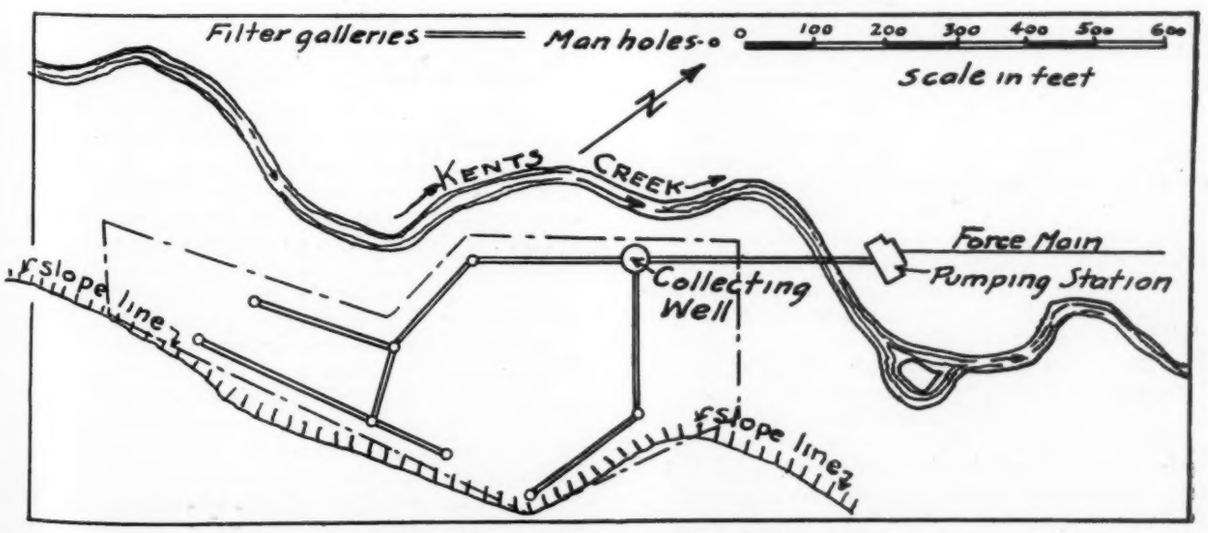
At the present time some thought is being given to the acquisition of considerably more land, it being felt that this should be done with a view to reforesting the adjacent area as a water conservation measure and also to preserve and keep uncontaminated at least the immediate part of the natural drainage basin.

To construct the original filter-gallery, excavation was made through the top soil and underlying sandy gravel and a line of perforated tile was laid, at an average depth of about 10 ft., first westerly and thence southerly in the flat areas between the stream and the hill. This conduit is 15 in. in diameter and is ordinary vitrified pipe in sections 2 ft. long. There are longitudinal oblong slots 2 in. long by ¼ in. wide in the upper half of the tile, there being four slots in each length of pipe in nine staggered rows. The unperforated or solid half of the pipe is laid to the bottom.

This conduit was laid with open joints and was covered with 16 in. of well rounded and screened natural gravel in size 2 in. down to ¾ in. before backfilling with the excavated material.

A number of manholes were also installed, these being built of brick laid in circular or well fashion with only the top 6 ft. cemented; this was done, of course, to prevent the entry of surface water. There is considerable infiltration of water through the lower brickwork into these wells and on later construction the size toward the bottom was increased giving not only larger collecting area, but also much better accessibility to the tile for cleaning. The tops of the manholes extend about 2 ft. above the ground level and are equipped with close-fitting bolted cast-iron covers.

Ground water with a temperature of about 46° F. enters the gallery through the slots in the tile and through the lower brickwork of the manhole wells. It then flows by gravity through a 15-in. cast-iron pipe across and under the bed of the creek to a sump-well located under the pumping station which is situated on



General layout of the Simcoe collection system

the north side of the stream. The land for the pump house and operator's residence was purchased for this purpose at the time of the original installation, and lies between the creek and a roadway. The soil formation here is different and no ground water is available.

As water consumption increased the need for augmenting the supply was met by simply extending the weeping tile or collecting galleries. Four extensions have been so constructed at different times and it is now believed that practically all the available water is being collected.

Additional water has therefore since been secured by gravel-wall wells at two other locations. The first of these is about a quarter of a mile southerly and is alongside the system's standpipe which is located in the highest part of the section, the base being 70 ft. above the level of the infiltration basin. The operation of this unit is controlled automatically by the level of the water in this tank. The other gravel-wall well is a half mile distant in the north part of the town. The water secured here, however, contains an objectionable amount of iron in solution and a treatment plant to remove it by aeration and base exchange is therefore being installed. The water delivered from this unit will thus be partially softened, the proportion treated by the two methods being such that the hardness will be reduced to about 100 p.p.m. It may be of interest to note also that the treatment in this plant, including the aeration, will be under pressure and no re-pumping will be done. Operation will also be automatic.

The original filter gallery remains however the system's largest and most economical source of a very satisfactory water.

Some difficulty has been experienced from sand and roots entering the tiles, but this has been taken care of, with one exception, by periodic cleaning with the usual sectional rods, ropes, and cleaning tools. Two years ago the capacity of the system was found, following a very heavy draw, to be reduced, and the section causing the trouble was located by checking the water levels in the manholes. All efforts to clear a blockage near a large elm tree having failed, an excavation was made, those tile found to be plugged with roots, replaced, and covered with fresh stone before refilling. This trouble no doubt arose due to failure to keep the galleries clear and more frequent cleaning was plainly indicated.

It is rather interesting to note that although the water in Kent Creek is at times contaminated, caused no doubt by run-off from nearby pastures and tilled fields, tests of water samples taken from test holes in the water supply-plain immediately adjacent have invariably been excellent.

However, a somewhat peculiar problem arose in making an extension in the southeast corner of the supply-area. In excavating for a manhole at the end of a gallery run in a southerly direction, a hard-pan or shale formation was encountered just about at the tile grade. About the same time the bacteriological tests of water samples taken at this point were unsatisfactory, due presumably to surface run-off from the hill which was not so steep in this part and was under cultivation. It was decided to break through the shale, and, fortunately water came up from underneath and flowed up out of a short pipe driven into the hard-pan. An inward sloping concrete structure was accordingly built up from the shale which was 12 ft. below ground level; the bottom inside the "well" so constructed was broken-out; and a solid tile run northerly from this "well" to the next adjacent manhole. The net result was a clear cold supply of about 150 g.p.m. which was a very welcome addition to the system.

At the time of the original installation an inlet was constructed in Kent's Creek near the intake conduit, and another supply line run to the pumping station; the idea being that in case of an emergency demand for additional water, as for instance to fight a serious fire, water could be obtained directly from the stream. This need has, however, not arisen and the use of water from Kent Creek would entail chlorination which has not so far been necessary with the ground water supplies of the Simcoe system.

Financial Data

Practically all water sold is metered, there being only 27 flat rates in the 1,615 services supplied. The total amount of water pumped last year was just under 140,000,000 Imp. gals., which averaged 383,000 g.p.d. or 72 gals. per capita. The total amount actually consumed was just over 114,000,000 gals., averaging 313,000 g.p.d. or 59 gals. per capita.

The maximum amount pumped on any one day in 1935 was on Monday, September 2, when a little over 590,000 gals. was recorded, and the minimum was on Sunday, February 3, with just over 70,000 gals. The total installed pumping capacity is at present a little over 2,000,000 g.p.d., which will be increased on completion of the second gravel-wall well and treatment plant to 2,500,000.

Of the water pumped into the system during the year just over 82 per cent was actually resold through meters, leaving 18 per cent used through hydrants, private fire lines, etc., and otherwise unaccounted for.

The direct cost of pumping water comprises electrical energy, fuel (in Simcoe's case natural gas), operating wages, and repairs and supplies for the pumping equipment and pumping stations. On this basis water is delivered into the Simcoe system at the pumping station for 4¼ cents per 1,000 Imp. gals.

This is 57 per cent of the operation and maintenance costs of the system which are made up as follows: Pumping, 57 per cent; distribution, 10 per cent; meter maintenance, 8 per cent; administration, 25 per cent.

It is to be noted that in the above cost figures no mention has been made of debt charges or of reserves for depreciation and contingencies. These factors apply to the Simcoe system and are provided for in its rate structure.

The above data are from a paper by Mr. Stalker before the Canadian section of the American Water Works Association.

Cleaning Sludge Beds in Schenectady

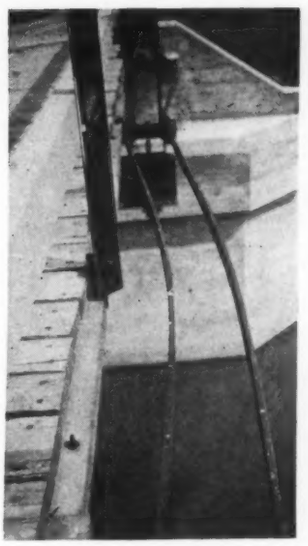
During the year ending Nov. 30th, 1935, 10,966 cu. yd. of Imhoff tank sludge was drawn onto the beds at Schenectady, N. Y., to a depth of 10 to 12 inches. A total of 94 drawings were made onto the ten beds and dried to 3,065 cu. yd. with a moisture content of 65% to 75%. A crew of two cleaning men and one team handled the beds in a satisfactory manner and were available for removing sludge from any bed approximately when the sludge reached a suitable condition.

Sale of sludge was more active than in recent years. The cleaning crew piled in a field, from which farmers removed it for composting during the entire summer. Also the city of Amsterdam removed 300 cu. yd. for use on its municipal golf course.

Continuation of the demand for sludge indicates that local farmers and householders are aware of the soil conditioning effect of the material. Many of the customers have been drawing sludge for ten years or more.

County Bridge Construction in Northern Michigan

By LOUIS F. LEVIN
Highway Engineer,
Chippewa County, Mich.



When piers slide, rods buckle like this.

THE work of the County Highway Engineer is interesting and it is made more so by the varied character of the people he must deal with and the conditions encountered. The problems are vastly different even in adjacent counties to say nothing of the several states. Each year the situation changes from the year before perhaps from natural causes having to do with the weather but quite often because of financial reasons. However, as separate from these considerations, it is worth while some times to stop and wonder what other County Highway Engineers would do with the same problem under like conditions.

Chippewa County lies at the most easterly point of the Upper Peninsula of Michigan. It is fairly well surrounded by Lake Superior, the largest fresh water lake in the world, and its connecting waters. By reason of this fact the county has five comparatively large rivers and streams. In each case these rivers run through the best of the farm land which is a heavy lake-bed clay. This clay has been the cause of many bridge and culvert failures in days gone by on both the County and State road systems. Box culverts have proved the most successful in deep narrow streams in preference to short span bridges with abutments and heavy backfills.

An even twenty years of experience with this soil has proven the futility of attempting to resist the action of unstable clay. All of these streams are subject to a scouring along the thread of the stream and there is a constant movement of the banks inward. On M-5 at the crossing of the Munuskong River there is a bridge upon which accurate records have been kept showing an abutment movement of six feet inward and approximately six feet downstream up to 1930. Four inches movement in one year was common until the backfills were removed and replaced with trestle work.

These experiences have led to the adoption by the County Road Commission of creosoted timber bridges. The bridges are made long enough to reach from bank to bank with a maximum of six foot back fill so that the superimposed load will be reduced to a minimum and will tend to eliminate the tendency of the banks to slide. This has been found much more economical and satisfactory than a shorter bridge with abutments and backfills. A second reason will be found in the fact that the counties of Michigan have been for the past five years taking over the Township road systems and this has brought on a deluge of old wrecks serving as bridges, most of them built upwards of thirty years ago.

Typical of the work being done by the County Road Commission of this nature is a bridge across the main branch of the Munuskong River recently erected. This bridge consists of three approach spans on each end of fifteen feet each, with a center truss span of sixty feet clear, making a bridge of 150 feet in length. Normally five piles are driven to each bent, using local piling of White Pine, Norway Pine or Tamarack, standard specification. These are driven by means of a drop hammer and leads operated by a small hoist and gasoline engine; 10″ x 10″ caps are used on all bents and 3″ x 6″ braces are used where bents are high enough to indicate the necessity. One ¾″ x 18″ drift pin is driven into a drilled hole in the cap for each pile. All piles and timber are given a hand painted

Views of the work described in the accompanying article. The author is shown in the center

coat of creosote and creosote is poured into each drift-pin hole.

In the particular truss referred to of 60-foot span and 16-foot roadway the bottom chord members were shipped direct from the mill on two flat cars to eliminate lower chord splices. The main truss members are 10″ x 10″. The floor beams are a select merchantable grade 6″ x 18″ side stepped to carry the knee braces and bolted together in pairs. Posts and braces are 4″ x 8″. All fir timber is No. 1 Common excepting the floor beams; 1-inch round rods in pairs are used for floor beam hangers and bear against suitable plates both top and bottom.

The framing of trusses was done in the shop during the winter months by snow plow operators in favorable weather between storms. Trusses were fitted and raised in the shop and bolts fitted and bolt holes burned out where necessary.

Thirteen lines of 4″ x 12″ stringers are used for these span lengths, and 14″ depth stringers are used on the 20-foot spans. For purely local reasons three-inch hemlock plank is used for flooring, and no doubt it would be found advisable to use something different in other localities.

A crew of five men is being used for the pile driving and the timber framing and erection. With this size crew approximately three weeks is required to complete the work as outlined exclusive of the backfills. The costs have been found very low for this type of structure averaging about $13 to $15 per running foot. On so-called Farm-to-Market roads where the traffic is mostly local, and on some County roads where it is difficult to predict what future needs will be, it is believed that the structure is entirely adequate for more years than it is possible to plan on traffic needs and road finances.

Stabilized Soil Roads

Laboratory research on soil road construction has recently produced much valuable information on the characteristics and effects of the numerous materials that are being experimented with to develop durable low-cost surfaces for secondary highways. Research work is being done by the Bureau of Public Roads of the U. S. Department of Agriculture, and by several State highway departments. Officials of these agencies recognize that highway development has reached a point where greater attention must be given to the roads that lead from the main highways. There are about 2,000,000 miles of unsurfaced road in the country.

The primary materials for the surfaces of soil roads are granular materials and a soil binder, usually clay. Common granular materials are: sand, gravel, cinders, and finally crushed stone or slag. It has been known for a long time that the granular material made roads stable in wet weather and that clay binder held the surface together in dry weather. New light is being thrown on the action of thin solidified moisture films in binding particles together, the conditions under which mixtures may be compacted to form dense surfaces and where special materials may be mixed in the surface to advantage.

Among the materials used are bitumens, Portland cement, slag, lime, limestone dust, common salt, calcium chloride and soap. Each of these materials is used for a particular purpose. Some materials or conditions will require one treatment and some another. Selection of the proper treatment is a job for the engineer with special training in soil work.

The work indicates that it will be possible to develop a variety of treatments, suitable for the many different conditions. A technical report entitled "Stabilized Soil Roads" has been issued recently by the Bureau of Public Roads. The report is prepared for use by engineers and summarizes results of field and laboratory research. It is not a manual of instructions for construction of low-type roads.

36 States Survey Highways for Road Programs

Highway planning surveys are now in progress or soon will begin in 36 states, according to the Bureau of Public Roads of the U. S. Department of Agriculture. The surveys are being conducted by the state highway departments with Bureau cooperation.

In the past attention has been centered on improving the main through highways. In the future more attention must be given, highway officials say, to improving secondary and feeder roads and to improving conditions where the main highways pour their traffic into cities. At the same time the main highways must be maintained and further improved to meet needs that already exist, particularly as regards safety.

Federal highway officials who are coordinating the various state surveys think that a selection should be made of those roads that because of their importance merit early consideration in an improvement program. Future programs can be planned intelligently only with information as to which roads should be improved first. To determine this highway officials need definite facts as to traffic counts, construction costs, maintenance costs, how much taxes can be fairly imposed for highway use, and where the taxes should be imposed from the viewpoint of highway usage.

Information along these lines is being collected in each of the state surveys. Each survey has three branches —a highway condition survey, a highway traffic survey, and a highway finance survey.

Increased Gasoline Taxes Curtail Car Use

Publication by the U. S. Bureau of Public Roads of motor vehicle registration data for 1935 has revealed that virtually every state which increased its gasoline tax rate last year either sustained losses in the number of motor vehicles registered or experienced subnormal increases in registration.

While motor vehicle registrations throughout the United States showed a gain of 5 per cent over 1934, the average gain was only 3.05 per cent for the five states which increased gasoline tax rates—Connecticut, Delaware, Nebraska, New York, and Pennsylvania.

Nebraska, where the gasoline tax was increased to 5 cents from 4 cents per gallon, was the only state to report a decrease in registrations in 1935. The decline was .1 per cent. New York state, where the gasoline tax was increased to 4 cents from 3 cents, had one of the smallest increases, only 2.5 per cent, or about half the average gain for the entire country.

Registrations increased only 4.3 per cent in Delaware, and 3.8 per cent in Pennsylvania. Connecticut was the only state increasing the gasoline tax rate to enjoy a normal gain in registrations, the increase of 6.1 per cent being ascribed to the fact that the higher gasoline tax rate did not become effective until late in the year.

While the purpose of increasing gasoline tax rates was to increase state revenues, the curtailment of the expected gains in registrations served largely to offset any gains in tax receipts.

A Rural Directory System

By HOWARD C. GRUBE
County Surveyor, Plymouth, Ind.

THERE is a growing demand for a simple system that will give rural homes an address that will make them as easy to locate as homes in the city. Improved facilities for travel have caused the lengthening of the RFD mail routes and they now cover wide areas. To locate a rural home is now more difficult than in the days of horse-drawn vehicles.

A rural directory system has been devised that gives every rural home a definite address. The rural directory plan, as here outlined, would make every farm home in the United States easy to find, even on byways and winding roads. With such a system in use, a farm home might be spared from burning; or a life might be saved in an emergency, if the home can quickly be located.

Road intersections and houses would be numbered according to their relative positions with reference to a standard known central point. The numbers are self-explanatory and no mathematical calculations are necessary to locate any point in the county. Generally the county seat is the logical central point from which to start the numbering system, since in most counties it is the most prominent place in the county. If the county seat is not centrally located it would have no effect on the working of the system.

Mr. Grube

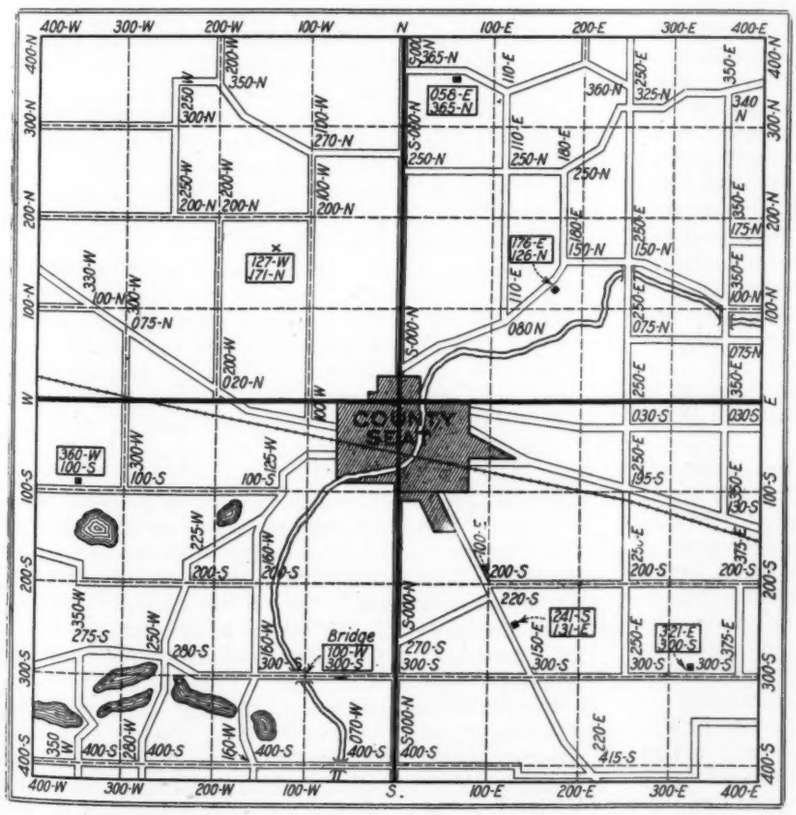
The United States land survey section lines that intersect nearest the central part of the county seat would be used as the east-west and the north-south base lines of the system. Each mile in any direction from either base line is numbered in units of 100.

How It Works

A road 2½ miles east of the north-south base line would be marked 250-E, meaning 2.50 miles east. A sign post bearing the numbers 250-E and 300-S would indicate its position as 2½ miles east and 3 miles south.

Houses would be numbered to the nearest .01 mile with the even numbers on the right and the odd hundredths on the left side of the road as the driver goes away from the county seat. Angling or winding roads would make no difference in the way the system worked, since the relative position of any farm house would be indicated in exactly the same manner as if the roads followed the section lines.

Suppose, for example, that you are at some point within the county and want to go to the county seat. You know the county seat is the origin of the numbering system; so when the sign at the first road intersection reads 350-E, 340-N you immediately know that you are 3.5 miles east and 3.4 miles north of the county seat. Now which is north and south and east and west? This is very easily solved at the first house number. If you are on an east-west road and the first house number is 325-E, 340-N, then you know you have traveled from east to west ¼ mile, because you have moved from 350-E to 325-E. You would confirm this by noting that the house number 325-E is an odd number and the house is on your right. This illustrates that you are traveling toward the county seat which would be east of you in this example.



How rural numbers can be laid out.

Suppose, further, that you want to call on someone whose mailing address is RFD 4 of a certain town and state. It is quite simple to find the town on the marked state highway; but unless a house numbering system is in use, finding a farm on RFD 4 is another matter.

But with such a numbering system in use, you find the person you want to call on listed in a county directory or a telephone directory. The address is say 321-E, 300-S. You know at once that the general direction is southeast and the house is on the left side of the road traveling away from the county seat, because the number is odd. You will travel south on the road leading southeasterly until you reach the road intersection marked 300-S, then you travel east, observing the road intersections and the house numbers as you go, until you reach 321-E, 300-S where the numbers should be prominently displayed on the house or at the farm entrance along the road.

This plan will also work in counties that have not been laid out in sections one mile square. The county map could be divided in one mile squares and the bearing numbers for the road intersections determined from the map and then established. The system would then be operated exactly the same as in counties where sections have been established.

County bridges can be given numbers in accordance with this plan and would fit in with a system of keeping records of the structures. The structure number would indicate its exact position. Rural electric service can also make use of the system for their records and maintenance of their properties; and many other uses can be made of the system.

Abatement of Industrial Waste Pollution in Illinois*

THE year 1935 was particularly characterized by not only the intensive effort to abate industrial stream pollution but the actual abatement which resulted from these efforts. Early in the year all of the industries on the Illinois River were contacted and where necessary samples of their wastes collected. Realizing the sincerity of the Sanitary Water Board's efforts in working out solutions to their waste problems, the confidence and good will of practically all industries were obtained. Industries on this river responded and cooperated with our engineers in further studying some of the complicated industrial waste problems and some of these studies have gained national recognition. Probably most important of these is the work done at the distillery at Hiram Walker & Sons, at Peoria.

The following gives briefly the action taken at the various industries as a result of the Sanitary Water Board's contacts.

At Peoria—Hiram Walker & Sons, Inc. After considerable study by the plant research chemist, a relatively new type of treatment was worked out for their wastes, and equipment is now installed and in operation to completely treat the wastes from the normal plant capacity. Action is under way to have treatment units installed to treat the peak load. Through this process by-products are derived from materials formerly wasted and the revenue thus derived is paying a good return on the investment. Thus, through this insistent effort of the Sanitary Water Board the industry has profited financially in addition to keeping from the stream, wastes which were equal in strength to the sewage of approximately 1,000,000 people. The Barrett Company made necessary appropriations for changes at the mill, and the necessary sewer connection to discharge wastes to the treatment plant of the Peoria Sanitary District was completed in January, 1936. The Bemis Bag Brothers Co. made necessary connections so as to discharge their concentrated wastes to the Peoria Sanitary District treatment plant. U. S. Industrial Alcohol Co. had under construction a waste recovery plant to be completed during January, 1936. Commercial Solvents Corporation has been carrying on research relative to waste treatment and recovery methods and has retained consultants to make the necessary studies of this problem.

At Pekin—The Quaker Oats Company installed the necessary equipment to operate under a partially closed white water system and at present some of the difficulties encountered in this process are being ironed out, with the ultimate plan to completely close their system, as far as possible, and prevent the discharge of wastes to the river. At the Standard Brands, Inc., research work has been and is being conducted by the company to determine methods for recovery and subsequent treatment. Their studies have included observation of a treatment works of a similar plant in Denmark. A report has been made by their consultants and a decision as to the final treatment was to be made early in 1936.

At Marseilles—The National Biscuit Company plant making paper cartons has made changes within their mill and necessary equipment was added to operate "a closed system" which has resulted in considerable decrease in pollution. Certain-teed Roofing Products Corporation placed their closed system in operation early in 1935 and the only wastes discharged to the river are intermittent overflows from their white-water chest.

At Morris—The Morris Paper Mills placed in operation a partially closed system early in 1935 and further studies are being conducted by engineers toward complete closing of the system.

Mississippi River—During the year many thousands of dollars in equipment were installed at the Shell and Standard Oil refineries in the East St. Louis area which has resulted in a marked decrease in the floating oil discharged to the stream. There has been a marked decrease in the frequency of objectionable tastes in the water supplies of St. Louis and East St. Louis although there is still considerable work to be done to make further refinements in the refining process and changes are necessary to further reduce objectionable petroleum compounds entering the stream.

Canneries—Because of the exceedingly large corn crop many objectionable stream pollution conditions were caused by wastes from corn canning factories. A number of investigations were made and considerable progress is now under way to have the necessary improvements made at these canneries so as to prevent pollution during the 1936 canning season.

Mines—A number of cases of stream pollution by acid mine waters were investigated. Because of the enormous volume of water involved, few practical solutions to the problem were made but at a number of mines our engineers are working with the officials to effect means of regulating mine water discharges in accordance with the flow in the outlet stream so as to cause the minimum trouble. This is one of the problems which for a number of years has confronted the Sanitary Water Board and considerable more work is needed.

Water Softening Plants—The great increase in construction of water treatment plants also placed a new stream pollution problem before the Sanitary Water Board in the disposal of lime sludge from a lime-soda softening plant or the disposal of brine used in the regeneration of zeolite in that type of water softening.

*Condensed from part of report of Illinois Sanitary Water Board.

The Editor's Page

Costs of Sewage Treatment

As most frequently given, the costs of sewage treatment do not mean very much. There is no standard base, so far as we know, that can be used whereby a fair comparison can be made between the results obtained at different plants. This matter has become increasingly important with the growth of chemical methods of treating sewage, and with the use of various chemicals for coagulation or for other purposes.

It is going to be a matter of considerable difficulty to devise a basis of cost-keeping that will not be burdensome and costly in application and that will serve as a fair comparison for the different methods and processes of treatment. Among the factors that add to the difficulty are the variations in the volume and in the strength of the sewage to be treated, and the similar variation in the percentage of reduction of objectionable elements in the sewage. These, of course, are only a few of the difficulties; many others will be found when the problem is subjected to the most casual analysis.

Our English cousins have gone somewhat farther in this line than we have and their experiences should be a help and a guide to us. Still, it is going to be a considerable and a thankless task. We suggest that the Federation of Sewage Works Associations and the Sanitary Engineering Section of the American Society of Civil Engineers, two organizations that have worked well together in the past, give this matter consideration through the appointment in the near future of a joint committee to study this problem, and to present a basis that will allow of a fair comparison.

More About the Weather

Last month on this page we tactfully mentioned the fact that winter was coming, and that snow would be in the air and on the ground later on. About the time that issue reached our readers, they were enjoying temperatures around or above the 100° mark. We expected our warning would be that untimely, but here goes for another. And this, despite the old, old story about the boy who gave the wolf alarm so often that when the wolf did arrive, no one believed him. We suspect that when winter comes, most everyone is going to know about it. To most of us comes a warning in the shape of a coal or oil bill, for one thing.

There is also the story about the old man from Jerusalem who slipped on something or other and fractured his allamagoozelum. Whatever that may be, it serves to allow us to point out that the slippery substance may have been ice; and, furthermore, that planning for control of icy streets and roads needs early attention. Sand, with a small calcium chloride or salt admixture, is a necessity under such conditions. While it is true that people drive more carefully when roads and streets are coated with ice, and there are perhaps fewer fatal accidents, nevertheless there is usually an increase in minor accidents and a considerable slowing down of traffic flow. It is the duty of the community to maintain roads and streets in a safe condition. This can best be done by prompt application of sand or cinders.

The actual hauling of the grit, and its admixture with chloride or salt can wait till October or November; maybe even later. But the planning for it ought to begin right now.

Mixing in Chemical Precipitation

Another step toward putting chemical treatment of sewage on a sounder basis has been made in the demonstration that thorough mixing of the chemical with the sewage is a necessity for economical and effective coagulation. Without this mixing, results are often unsatisfactory and the turbidity of the sewage remains high.

Either mechanical or air mixers give these good results. Further, both of them cost but little; and the structures, the mixing tanks, in which they are used are also relatively cheap to build. As a result, it is possible for many existing sewage treatment plants to add chemical precipitation to provide for overload or to improve the quality of the effluent during those periods of the year when improvement is needed.

It is believed that a mixing tank, with proper mixing equipment, to serve a plant with a capacity of a million gallons of sewage a day, can be constructed for considerably less than $5,000; in most cases it can be done for around $3,000. The installation of such mixing apparatus and the use of chemical treatment for three or four months each year would undoubtedly eliminate the complaints that beset the officials of many of our cities, towns and villages each summer.

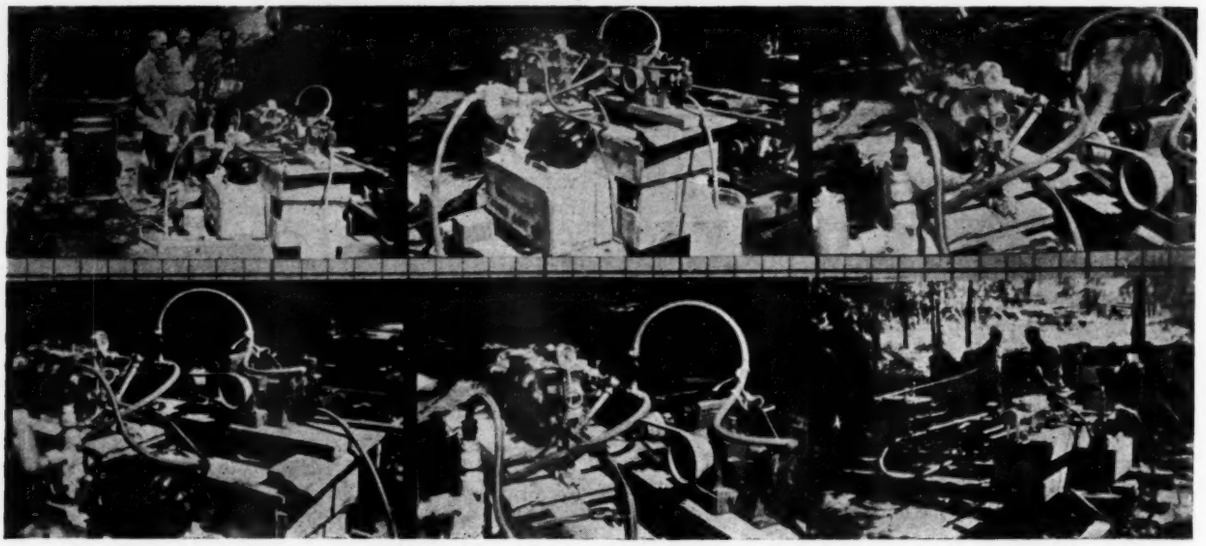
We urge that our readers consider this. The Editor will be glad to assist in getting in touch with proper sources of information regarding the possibility of this low-cost method of improving the quality of sewage effluents.

Military Water Supplies

Military water supplies are of two general classes, for which the requirements are vastly different. Supplies for cantonments, posts and flying fields, and for other places of a similar nature, do not differ materially from the supplies serving our communities in time of peace. Water supplies for armies in the field have in common with the other problems only the requirement that the water be safe. Quantity, taste and appearance are largely forgotten. Or they have been in the past; they may not be in the future.

On another page of this issue are reported some investigations of this problem. These may open a new consideration of this problem. Soldiers at the front or on the march will drink any water if they are not supplied with safe and attractive water. The result is intestinal diseases that reduce the efficiency of the troops.

If safe water, sufficiently attractive to compete with unsafe brook, well or other waters can be provided, much of this loss from intestinal disease can be avoided. The tests reported seem to show that, using a modern, light-weight filter, a light truck fully equipped to accompany the troops any place any other truck can go, can be counted on to furnish a safe and attractive water under many conditions considered impossible with present equipment. The problem of water supply to the very front line is still really unsolved, however; that is the next question to consider.



Various views of the Shriver filter and the test work. Upper left, Col. Sweet, Lt. Dickerson and Lt. Culley; lower right, Major Souder and Capt. Hatch. Seitz filter is also shown in this view.

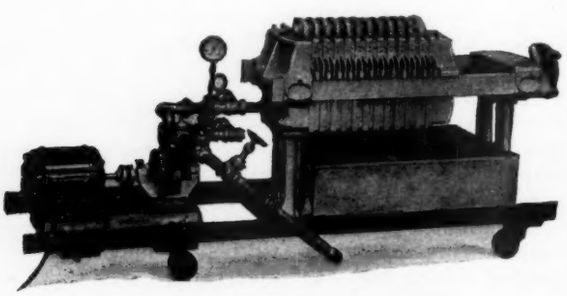
Experiments on Water Purification for Army Use

IMPROVED methods of water purification for use under army field conditions were studied by the Class in Military Sanitation during the July camp period at the Medical Field Service School, Carlisle Barracks, Pa. This study was begun in 1935, and data have been collected and preparations made for field tests during the intervening period. In the tests made last month, the equipment was set up and run under actual field conditions.

Three types of filter units were tried out, a Shriver, a Seitz and an engineer corps unit. A brief description of these follow:

Shriver—This consists of a metal frame supporting 11 filter plates, each 7 inches square; 15-oz. woven filter cloth was stretched over the plates, and the cloth coated, before filtration, with Johns-Manville filtercel. This is a prepared diatomaceous earth that acts in this unit in the same way that the *schmutzdecke* acts on the usual type of filter. Asbestos cotton fiber was also used in place of the filtercel, and the two were also used in combination. The total filter surface of this unit was 3 square feet. A Proportioneers chlorofeeder was connected to this unit, so that chlorination, using HTH, could be applied.

Provision is made in this filter for cleaning by means of backwashing, so that when the loss of head becomes too great it is necessary only to reverse the flow to clean it, and then recoat with filtercel or cotton-asbestos mat. During the work, the filter was frequently taken apart—it was a matter of only a few minutes work to dissemble, inspect and assemble the unit. In actual filtering work, this would not be necessary except at infrequent intervals.



The Shriver filter unit

This unit was constructed especially for the work by T. Shriver & Co., Harrison, N. J. A general view of a similar unit and a section showing the arrangement of filter plates and frames are shown herewith.

Seitz—This unit also consists of a metal frame supporting 14 metal plates between which were placed 13 Asbeston cotton fiber filter pads. No coating is needed on the filter, and backwashing is not possible. When the pads become clogged, the plates must be dissembled and the pads removed and replaced, which procedure requires only a few minutes. The outside of the frames were 20 inches square and the effective filtering area was 18.4 square feet.

Engineer Unit—This was a cylinder 1.05 ft. in diameter and 2 feet long, with a 2-inch nipple in either end. Filter inserts consisted of army blanket material. Washing or cleaning was accomplished by disconnecting and reversing the direction of the flow, wasting the first run. Under the conditions of the test, this unit failed to provide clear and satisfactory water and further consideration of it will be omitted here.

Characteristics of the Raw Water; Equipment

The water used throughout was taken from Letort Run. The raw water had a color of 5; a pH 8.0 to 8.2 and a turbidity varying with construction work above from 15 to 200, often changing rapidly. Bacteria counts ran up to 2,000 and occasionally higher, with most samples showing positive for B. coli.

The Shriver filter was fed by a Wesco centrifugal pump driven by a ½ h.p. Century motor. As already stated a Proportioneers chlorinating unit was mounted alongside the filter, feeding to the discharge line. The

Seitz filter was fed by a small rotary type pump driven by a fractional horsepower air-cooled Briggs and Stratton engine. The pump did not have adequate capacity for the unit. A Homelite portable gasoline engine driven pump was also used to pump water into two 1,500-gallon canvas tanks which were used in presettling work.

On the Shriver unit, standard filtercel was normally used at the rate of 2 ounces per square foot of filter area. This was mixed in 5 gallons of water and applied to the filters. High-flow supercel was also used, but not enough work was done with this material to justify forming an opinion of its relative value. Eaton-Dikeman asbestos cotton fiber cuts were also used for coating. On the Seitz unit, Seitz asbeston cotton fiber filter pads, types K-3 and I-600, and Eaton-Dikeman pads No. 1 and No. 2 were used.

Operation Results

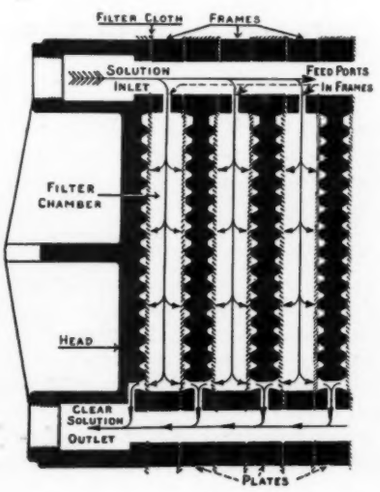
Both the Shriver and the Seitz filter at all times yielded an effluent free from color and practically free from turbidity—always below a turbidity of 2 or 3—no matter how high the turbidity of the applied water. The only effect of increased turbidity was to shorten the filter run, which was expected; but turbidities less than about 50 did not appear to affect materially either the rate or the total amount filtered before washing was required.

The Seitz filter showed exceedingly high removal of bacteria. Many of the samples from this unit containing less than 50 colonies per cc.; some of them were sterile. Bacterial counts on the effluent on the Shriver filter were much higher, ranging up to several hundreds. For the work contemplated, this is considered unimportant, since all water will be chlorinated. The aim in military water supply is to produce a water as clear and attractive as is possible, but especially to produce water that can be sterilized with a moderate dose of chlorine. Both the Seitz and the Shriver filters exceeded all requirements in this line.

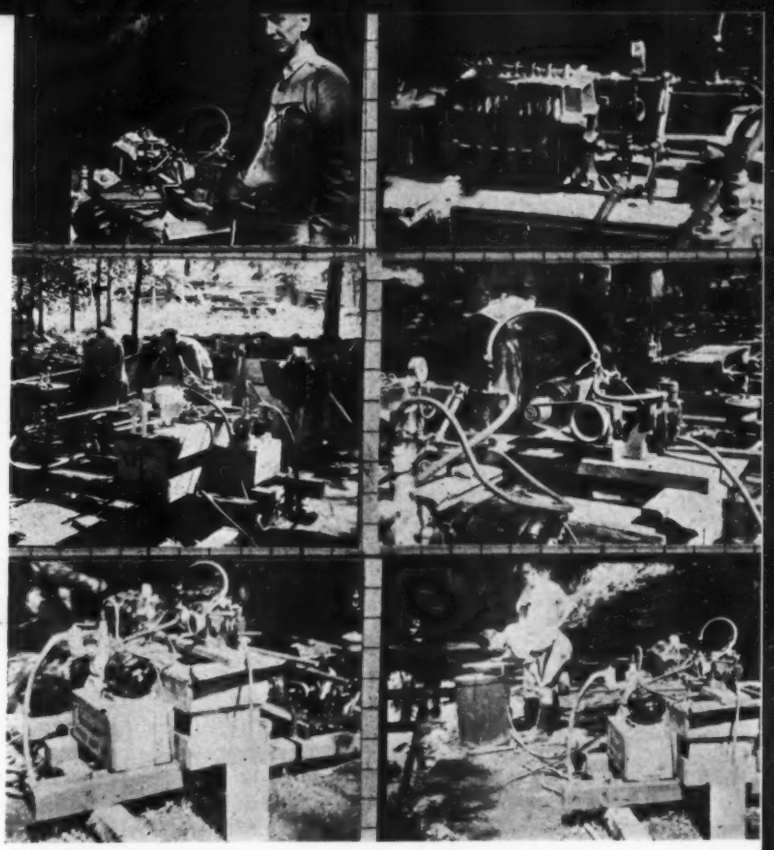
Volumes and Capacities

The output of the Shriver filter varied from 4 to 6 gallons per minute, averaging about 5 gallons. This is at the rate of 1.67 gallons per square foot of filter area per minute. A resume of various runs follows:

Turbidity	*Time Minutes*	*Delivery Gallons*	*Rate, g.p.m.*	*Coating*
90-200	27	80	3.0	Filtercel
17-60	48	200	4.1	High-flow
35	27	120	4.5	High-flow
21-69	47	200	4.2	Asbestos-cotton



A sectional view of the Shriver filter showing plates or frames, filter cloth placing and flow of water.



Upper left, Col. Sweet; middle left, Maj. Souder and Capt. Hatch. Midget Chlorofeeder and Seitz filter shown in middle right. Lower right, Lt. Dickerson.

23	19	115	6.0	Asbestos-cotton
160	45	200	4.45	Filtercel
40	41	205	5.0	Filtercel
14	73	240	3.3	Asbestos-cotton
14	37	200	5.4	Filtercel
9-11	131	436	3.4	Filtercel*
40	65	205	3.2	Filtercel
40	63	320	5.1	Filtercel
**	59	240	4.0	Filtercel
**	57	240	4.3	Filtercel
11	65	200	3.1	Filtercel †

*Additional small dosages of filtercel were given at 216 gals., 316 gals. and 416 gals. **Coagulated water used. †Activated carbon was used in this run and appeared to reduce the capacity.

As previously stated, all runs produced exceptionally clear and attractive water of less than 2 turbidity. Washing of this filter requires 5 to 10 minutes of time and about 5 gallons of water. On the basis of average runs, the wash water requirement will be 2% to 3%.

The Seitz filter ordinarily produced from 18 to 25 gallons per minute, or from 1 to 1½ gallons per square foot of filter area. With a larger pump, this probably could have been increased. A resume of some of the typical runs follows:

Turbidity	*Time Minutes*	*Delivery gallons*	*Rate gpm*
14-90	53	1130	21.4
50	40	814	20.4
.....	60	1260	21.0
25	74	1300	17.5
40	68	1160	17.
17	55	1290	23.4

The Seitz filter is not washed; the pads are removed and replaced. Under the severe conditions of the test, replacement of the pads on the Seitz filter would be necessary every 2,000 to 3,000 gallons; the manufacturers state that with coagulated and settled water, this unit would have a capacity of 30,000 to 40,000 gallons before the pads would require removal. The Shriver filter must be washed after 200 to 400 gallons of water

of the quality used in these tests has passed through it. Thus, it is indicated that with the water used, washing of the Shriver is needed after 80 to 130 gallons per square foot of filter surface has been passed, and pad replacement on the Seitz is necessary after 125 to 150 gallons per square foot have been filtered. With clear or well settled water, both of these units would show very much longer runs.

Both units are very light in weight, especially as compared to the usual sand-filled pressure filters. For military use, either one could be provided in size to yield 25 to 40 gallons per minute; a light truck could carry such a filter, 2 or 3 pumps, a chlorinator, and two 1,500-gallon canvas tanks. Such a unit would be highly mobile. It is also possible that a unit like the Shriver could be equipped with a hand pump and carried by infantry under almost any conditions.

Where clarity of effluent is a factor such as in some swimming pools, and in camp and estate or home water supplies, these filters should fill a long-felt need. Both yield a very fine effluent and are simple to operate. In connection with a small chlorinator, really fine small supplies are possible. At present, the operating cost favors the Shriver, since the filtered coating is much cheaper than the filter pads used in the Seitz.

This work was carried on by a group of reserve officers under the general supervision of Lt.-Col. A. W. Sweet of the New Jersey Department of Health, assisted by Lt.-Col. F. E. Daniels of the Pennsylvania Department of Health; Major Charles Gilman Hyde, Professor of Sanitary Engineering of the University of California; Major F. H. Stover of the Louisville Water Dept.; Major E. C. Martindale, U. S. Public Health Service, New York; Capt. B. J. Hatch of the Ohio State Board of Health; Lt. Albert L. Scott, City Bacteriologist of Roanoke, Va.; Lt. Bruce Dickerson, Chief Engineer, Hungerford & Terry, Clayton, N. J.; and Lt. Walter Culley, of the Chester, Pa., Water Dept. Major C. G. Souder has been in charge of the Department of Military Sanitation at the Medical Field Service School; and Lt.-Col. W. A. Hardenbergh was in charge of the work and training of the Class in Military Sanitation.

Stone Chippings for Surface Dressing

A SUMMARY is given of the replies by the Chief Road Engineers of 18 French Departments to a questionnaire circulated to them on road stone. It is agreed that the stone should combine hardness with mechanical strength, and should break into cubic or prismatic fragments, with sharp edges and rough surfaces; other desirable qualities are cleanness (sometimes to be achieved only by washing), suitable grading, light color, non-hygroscopic character and absence of lubricating power in the abrasion products. The two final items are emphasized in replies from areas where the rainfall is considerable. Opinions differ regarding the influence of the type of stone (assuming this to be of good quality) on the adhesion and durability of the surfacing, but adhesion between aggregate and binder and the wearing quality of the stone must necessarily be of importance, especially if the proportion of binder is low. The non-skid character of a surfacing depends to a great extent on the nature and condition of the chippings; the wearing surface must present a mosaic of uncoated stone in order to be reasonably free from skidding. Hardness, durability and resistance to wear do not necessarily all occur in any particular stone, and in selection a balance must generally be struck. For general use, the order of preference is the following:—quartzite, diorite, granite, basalt, porphyry, quartzitic sandstone. In France quartzite and porphyry are the most readily obtainable, and are hence the most widely used. If tar is used as binder, chippings of somewhat inferior quality may be employed, e.g., limestone or flint; the latter, however, has a smooth conchoidal fracture, especially if the opaque "gangue" is absent, and adhesion is consequently poor. Slag aggregate has been used successfully with bitumen emulsion. The sizes of chippings recommended are 0.2 to 0.6 in., 0.2 to 0.8 in. and 0.2 to 1.0 in.; in the case of tar surfacings, a subsequent application of sand is recommended, in gradings 0.12 to 0.32 in., 0.04 to 0.2 in., or 0.12 to dust. Where bitumen emulsions are employed the stone should be slightly moist; in other cases it must be dry. Grading must be governed by the quantity as well as the nature of the binder. Binders employed cold require a maximum size of about 0.6 in., whilst with more viscous materials, normally applied hot, 1.2 or 1.6 in. is not excessive if good adhesion can be secured. Heavy traffic, which tends to embed the stone in the binder, requires a coarser aggregate than comparatively light traffic. The use of fairly coarse chippings is also of value if the surfacing contains too high a proportion of bitumen or tar. Opinions are divided regarding the amount of stone to be used; an average of 0.3 to 0.36 cu.ft./sq.yd. is recommended, the corresponding quantities of tar, filled tar and 50 per cent. bitumen emulsion being respectively 1.7 to 1.85 lb., 1.85 to 2.2 lb. and 2.4 to 3.3 lb./sq.yd. In the case of heavy bituminous binders applied hot, stone is used at the rate of about 0.45 cu.ft./sq.yd., together with 1.7 to 1.85 lb. of pure bitumen. Mechanical spreading is recommended, as improved adhesion is secured by the application of the stone directly after the binder has been spread and immediately before the surface is rolled; distribution is more rapid and uniform and less chippings are lost than when the stone is spread by hand. Mechanical methods are not employed in 5 departments, and are used elsewhere to a widely varying extent. Rolling is considered essential, except in the case of tar carpets. A 6- to 8-ton roller should be used when the binder is of low viscosity, and a 10- to 12-ton roller for heavier binders and harder aggregate. Rolling should take place immediately after the chippings have been spread in the case of hot bitumen, and in that of bitumen emulsion after a slightly longer interval, preferably shortly before the emulsion breaks.—*Science et Ind.*, 1935, (258 bis), special number *La Route*, 59-62.—*Road Abstracts.*

Hydrologic Data To Be Issued

A review of unpublished hydrologic data will be made by a sub-committee of the Water Resources Committee of the National Resources Committee. C. S. Jarvis of the Soil Conservation Service will have general supervision over this investigation. It is intended that this review will result in the publication of an index of unpublished hydrologic data giving the type of data, period of record, the location of the data and its estimated reliability. The sub-committee believes that this information will be highly useful to hydrologists, engineers, and other technicians engaged in the design of small water storage structures. At the present time there is a great deficiency in published data relating to small drainage areas.

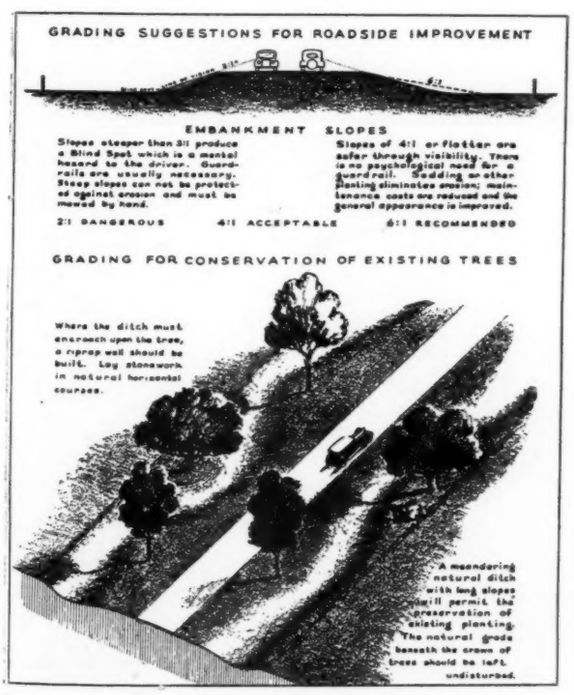
It is anticipated that this undertaking will be complete within approximately four months.

Bank stabilization and planting in Massachusetts

The Purposes of Roadside Improvement

THE advantages of roadside improvement are too often viewed merely from the standpoint of better roadside appearance, and the more important phases of well-planned work of this type are overlooked. Here are some of the purposes that should lie behind all planning for roadside improvement:

Safety.—One great purpose is the reduction of traffic accidents. Shoulders should be wide enough to allow the parking of the largest vehicles clear of the pavement, and also to accommodate horse drawn vehicles and pedestrians. It has been shown that this one feature—wide shoulders—will cut the total accident rate in half. Flat front and back slopes and a side ditch of minimum depth, protected against erosion, will prevent serious accidents to cars forced off the pavement surface. Flat back slopes and a properly planned right of way assure the maximum sight distance. Building lines and billboards, held back because of the wide right of way, eliminate blind spots and reduce "driver distraction." Generous layouts at intersections create greater safety.


GRADING SUGGESTIONS FOR ROADSIDE IMPROVEMENT
EMBANKMENT SLOPES
Slopes steeper than 3:1 produce a Blind Spot which is a mental hazard to the driver. Guard-rails are usually necessary. Steep slopes can not be protected against erosion and must be mowed by hand.
Slopes of 4:1 or flatter are safer through visibility. There is no psychological need for a guard-rail. Sodding or other planting eliminates erosion; maintenance costs are reduced and the general appearance is improved.
2:1 DANGEROUS
4:1 ACCEPTABLE
6:1 RECOMMENDED
GRADING FOR CONSERVATION OF EXISTING TREES
Where the ditch must encroach upon the tree, a riprap wall should be built. Lay stonework in natural horizontal courses.
A meandering natural ditch with long slopes will permit the preservation of existing planting. The natural grade beneath the crown of trees should be left undisturbed.

Suggestions for roadside improvement

Side ditches properly lined and protected are no longer subject to erosion and the resultant constant repair. On perfectly constructed earthwork, practically nothing except mowing is left for maintenance, and this can actually be eliminated in time through the establishment of low-growing, better grasses, instead of the usual rank growth. Also, on such well constructed slopes, mowing is considerably cheaper.

Lowered Maintenance Costs.—Maintenance costs in highway work are exactly as they are in other lines of business—they are in direct proportion to the class of construction. The more perfect the construction, the lower the maintenance costs. Erosion is one of the greatest causes of maintenance costs. Flat slopes, under grass, reduce erosion. A rim or berm ditch, which is needed in certain cuts to protect the back slope against erosion, will pay many times over through the season for the cost of constructing it. The reason for the rounded back slope is not primarily for appearance, but because grass will take on it more readily.

Pavement maintenance is not the most serious item entering into costs; these are attributable mainly to other elements. But even pavement maintenance can be substantially reduced by proper roadside improvement, since these tend not merely to repair damage, but to eliminate the causes.

Better Appearance.—On road work that includes the proper elements of design, appearance will always be satisfactory; and these same elements that create a good and orderly appearance, also create safety. The first step toward improving appearance is, of necessity, the securing of an ample right of way, whether this extra space serves another purpose or not. These rights of way, allowed to develop in native tree growth,

properly cleared and maintained, really constitute a park system from one end of the state to another. As the work develops and further money becomes available, there is no limit to which further roadside development may be carried through planting and landscaping, provided proper elementary work has been done.

Provision for the Future.—A prime purpose of the wide right of way is to provide room for future development in pavement requirements, but there are also many other factors that make this desirable. When the roadside becomes developed, as generally happens along major routes, it is too late to obtain additional rights of way. Not all of the state highways will carry enough traffic to justify more than two lanes, but some of them will. On such heavily traveled highways, the present trend of thought is toward divided lanes, with two 20-foot pavements separated by a parkway. Such a highway will handle more traffic, and handle it more safely, than one 40-foot pavement. Movement is all one way, headlight glares are eliminated and traffic maintains its proper position on the lane.

On present construction, with a 200-foot right of way, it is desirable to place the initial pavement off the true center, thereby leaving room for progressive development as demanded by traffic density or traffic safety.

The above statement is based on data issued by the Florida State Road Department, and much of it refers to conditions in that state, though the base facts apply almost as well to all other sections of the country, except the more thinly settled ones; and even these, as shown by recent articles in this magazine, have been alive to the many benefits of roadside improvement, which term should be understood in its broadest sense, and not merely as denoting the construction of an occasional flower bed or the planting of a few shrubs.

Use of Stabilizing Emulsion

By HARRY GOODRIDGE

City Engineer and Superintendent of Streets, Berkeley, Calif.

IN CONNECTION with one of the Works Progress Administration Projects, it became necessary to find some means of building a temporary road over a new fill made around a lake. The water in the lake was at elevation 7 and the finished roadway could not be above elevation 8½. There was considerable possibility of capillary action which would ruin the subgrade.

Experiments had been made with some of the clay in the roadway to determine if it could be made impervious to water by mixing it with a stabilizing emulsion. These experiments proved sufficient but it required that about 10% by weight of emulsion be added to the clay. Search was made for a material which would require the minimum amount of emulsion and yet have a sufficient amount of fine particles to bind the mix. This material was found, having about 20% passing a number 200 sieve and requiring only 3% by weight of emulsion. The emulsion used was the product manufactured by the American Bitumuls Company.

It would have been a waste of money to build a permanent type of roadway over this new fill. The roadway was graded in such a way as to permit the application of 6" of the selected material. This material was thoroughly watered to such an extent as to entirely break down all lumps. The mixture was made sufficiently wet and of such a consistency that it would flatten out with its own weight. The material was turned over three or four times as the emulsion was added, care being taken to entirely coat every clay particle.

The material was then leveled off by means of a tamping bar in much the same manner as is done on some concrete highway work.

The drying process caused considerable cracking. This was necessary in order to permit thorough drying for the entire thickness of 6". The drying process continued over a period of two or three weeks. The cracks would then be filled with a very thin mix of the same material; the cracks being filled by moving the material over the surface with a large broom. After the surface was thoroughly dry a 1½" wear coat of rock and penetration emulsion was applied and the road thrown open to traffic.

Very satisfactory results have been obtained. The accompanying pictures indicate the different stages of construction.

Top, the road; next, mixing and finishing; bottom, filling the cracks

Notes from Haverhill, Mass., Water Works Report

Up-to-Date Practices in a City of About 50,000 Population

Advantage of Proportioning Chlorine Dose

"The aversion to adding chlorine to drinking water still exists in the minds of some consumers. This may possibly be attributed to their having had contact elsewhere with water having a heavier dosage of chlorine than that applied in Haverhill. This condition may exist where the demand for water practically ceases during the night time, and with the older type of apparatus it is difficult to secure a variable dose, with the result that overdosing occurs. Our chlorinators, installed in 1933, are automatic, this improvement assuring us of a variable application at all times."

Copper Service Pipe

"The labor cost for installation of water service pipes is the principal item, therefore, it is desirable to reduce renewals. In order to eliminate renewals also the disturbance of improved paving, which is costly and for obvious reasons should be discouraged, the Board has adopted seamless copper tubing which as regards durability, has many times the bursting pressure of lead pipe. Ordinarily a lead service pipe will break on the second freezing while a copper service pipe may be frozen anywhere from five to six times, without rupture, due to the extruding property of copper. It will not scale and it resists corrosion better than any other material used for water service pipe.

"The cost of a 50 foot ¾" lead service is $49.22 while the same service in copper is $38.98, a difference of $10.24 or a saving of over twenty per cent to consumers."

Meter-Master Convinces Consumers

"In order to improve customer relationship, new methods are proving effective. Meters are now read quarterly, customers being notified if there is excess consumption. If they are unable to account for excess, our Inspector checks all plumbing in the house. Very often these examinations reveal leaky fixtures, especially the flush boxes of toilets. The Meter-Master is an outstanding agent in settling disputes of high water bills. This equipment is attached to the meter and a chart is made of the flow during a twenty-four hour period. This instrument obviates the necessity of temporary installation of a test meter to prove the consumption. When the chart is removed at the expiration of the twenty-four hour period, it shows very plainly when water has been used as well as the peak hours of consumption. The complainant is invariably convinced that he has used the water and that his bill is correct, when shown the registration on the Meter-Master chart. It is only in rare cases nowadays where we are requested to test a meter."

Mechanical Aids in Water Accounting

"A survey was made of the business machine market for the latest improved equipment applicable to water accounting operations. Other cities, where modernization of water accounting had been accomplished, were visited to ascertain whether or not any improved features of these systems were adaptable to ours.

"The first and most serious problem to be corrected was the manually writing, computing and proving fixture rate books, meter ledger cards and assessment records. This solution lay in use of mechanical data-writing and computing equipment such as is used in private business practice.

"The time and labor involved in writing bills and inspection books was reduced manyfold by installing an Addressograph machine which mechanically, and largely automatically, prints from embossed plates, all descriptive data regarding each account.

"Under our former system, there was more or less confusion and conflict between the rotation of accounts in the ledger and the order of arrangement for convenience of the meter reader. This was due to the fact that the ledger accounts were under alphabetical sequence, which made it difficult for the meter reader to follow, without covering the same ground more than once.

"The present system is divided into three districts, designated by the letters A, B and C. A meter reading book is made up of approximately one hundred accounts, each book being numbered consecutively. Each sheet is numbered consecutively in intervals of 5's leaving space between available for additional accounts. This numbering coincides with the ledger card record. For instance A-7-525 means District A, meter book number 7 and account number 525 in book number 7. This system is extremely flexible and will accommodate an indefinite number of accounts.

"Each consumer has an individual ledger card, which is filed in the same order as the meter book records. These are conveniently carried in metal trays having a wheel base made for convenience in moving about the office. Each tray contains approximately 2000 ledger cards. Individual ledger sheets furnish a continuous record of each consumer's account, thus making available information often required for comparative purposes. This ledger sheet is an excellent record to show a consumer. It is compact, and data of his neighbor's accounts do not appear before him. When an account is closed, the meter reader's sheet and ledger card are transferred to an obsolete file, but the account number is still maintained in case the account again becomes active.

"The work of billing and charging accounts is done mechanically. With the use of a billing machine the customer's bill, cashier's coupon, ledger record and recapitulation sheet are made in one operation. Arrears are also posted on the bill at the same time. This saves a great amount of clerical labor.

The billing machine has many automatic features. For example: the meter readings are set up on the machine but once and, due to a repeat mechanism, are printed on the ledger card, customer's bill and audit sheet. This also applies to the charges and arrears, which are printed on the customer's bill, cashier's coupon and ledger card. By mechanically repeat printing items from one form to the other, it is no longer necessary to compare the completed bill with the ledger.

Automatic carriage tabulation and automatic printing of ciphers simplify the operation. The forms are dropped to correct printing position without having to be aligned by the operator.The carriage opens automatically, facilitating the removal and insertion of forms. Labor-saving devices on the billing machine permit bills to be prepared with both accuracy and speed, also with a minimum of effort on the part of the operator.

"In addition to printing, the figures are accumulated to provide a complete proof of billing. A section of 100 or more bills are proved in the same manner a customer would check the accuracy of his own individual bill. The consumption is totaled and if an error in present and previous reading is made, the machine locks.

Feather River Highway Tunnels

THERE are three tunnels on the Feather River Highway which the State of California is constructing through the famous Feather River Valley. No. 1, about 33 miles east of Oroville on the Arch Rock section of the road, is 265 feet in length. Nos. 2 and 3 under Grizzly Dome are 390 feet and 1,172 feet in length, respectively.

Rapid construction progress is being made on the new highway. Approximately 35 miles of the project from Oroville to Grizzly Dome are practically completed. About 2.3 miles of heavy grading between Grizzly Dome and the Rock Creek bridge remains to be done. Between this bridge and the Storrie bridge 2.6 miles of road have been practically finished, and between Storrie bridge and Tobin bridge 1.5 miles are under construction. A stretch of 30 miles between Tobin bridge and Keddie is almost completed.

The finished cross section of the tunnels will be 30 feet, 4 inches in width and 22 feet, 2 inches in height, which includes sufficient space for lining should it become necessary. The spring line is 7 feet above profile grade.

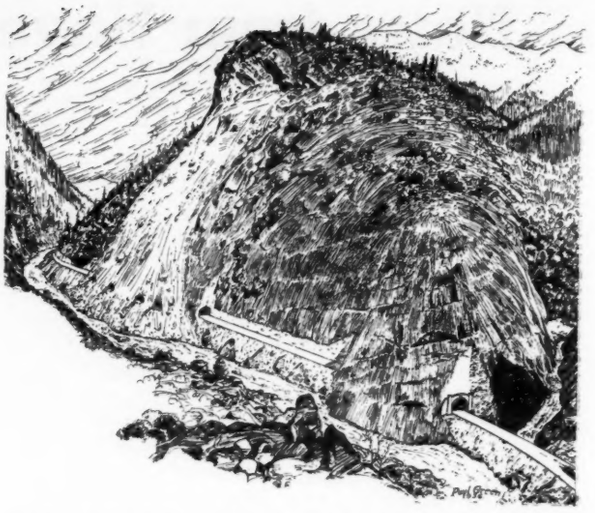
The first step in the construction of Tunnel No. 1 was boring a center heading 14 feet wide and 8 feet high. Drilling for blasting was accomplished with four drifting drills mounted on two eight-foot columns with three-foot arms. The muck was removed by hand methods with cars and track. Two crews, working eight hour shifts, one drilling and blasting and the other mucking, advanced the heading an average of five feet per day.

Excavating the enlargement consists of removing a ring of rock, 6 to 8 feet in thickness. This is being done in one operation by ring drilling and vertical down holes. Two eight-foot columns, supporting four drifting drills, are set up in a vertical position in the previously completed center heading, 3½ feet on each side of the tunnel center line.

From this setup, holes are drilled radially in the sides and top at the proper angle to space the ends of the holes at two-foot centers.

Two rings, three feet apart, are drilled without moving the columns. Vertical down holes are drilled in the bottom section with hand held rock drills in advance of the ring drilling. A full ring is blasted in each shot. The top and sides are fired with instantaneous detonators and the bottom with delays in order to throw the muck away from the face and avoid obstructing the heading.

The correct angle of the drills to space the radial holes accurately is determined by means of a clinometer devised on the job. Muck from the enlargement is being removed with a 75-h.p. diesel tractor and scraper.



No. 2 and No. 3 Tunnels of the Feather River Highway through Grizzly Dome. The longer is 1172 feet in length with 4 adits or windows.

The enlargement of Tunnel No. 2 was excavated by a different method. A top heading, 14 feet wide and 7 feet high, was driven in the same manner as the center heading in Tunnel No. 1. Four operations were then required to complete the tunnel.

The first two operations consisted of removing benches approximately six and nine feet in depth, and fourteen feet wide, the first being completed before the second was started. Thus, a section in the center of the tunnel, fourteen feet in width, was completed. Following the last bench by about fifty feet, the upper halves of the blocks of material remaining on the sides were taken out to full width. Widening the sides to grade was completed in the last operation.

Hand held rock drills were used on the vertical holes in the benches, spaced two feet apart transversely and three feet longitudinally. Four transverse rows of holes were fired in each blast with delay detonators.

Holes for blasting the sides to full width were drilled twelve feet in depth and approximately parallel to center line and grade, with four drifting drills, two on each side.

The number and spacing of these holes were varied according to the condition of the rock encountered.

A 60-h.p. tractor and scraper were used to remove the muck from the enlargement.

Four portable compressors, having total rated capacity of 1,660 cubic feet per minute, furnish compressed air for 12 rock drills. The compressors are connected to one four-inch air line, 3,200 feet in length.

The above information is abstracted from a report by G. M. Webb, resident engineer, in *California Highways* and PUBLIC WORKS.

Building a Sewage Treatment Plant in Another State

Bluefield, W. Va., which is located very near the Virginia border, has recently been upheld by the State Supreme Court in the construction of a sewage treatment plant in the adjoining state of Virginia. The new plant, which is a $500,000 PWA project, serves Bluefield, W. Va., but is located in adjacent Bluefield, Va.

WHAT A BEATING BEADS* TAKE ON DUMP TRUCKS!

—But Beads in Improved High Profile Goodyears Can Take It

Improved High Profile Goodyear Truck Tires are made with heavy, braided-wire beads, securely tied in by the plies of the tire. And your truck tires need strong, dependable beads just as an athlete needs strong ankles.

You'll get better performance from these improved Goodyears. Ask your Goodyear dealer to show them to you.

They are bigger, sturdier, tougher—more rubber, more cotton, more air space. They have longer side walls. That means less generation of heat, more diffusion of heat that is generated. In every way they give you more for your money—yet they cost no more.

Other reasons why they're MONEY SAVERS are these: Supertwist Cord construction—All-Weather tread—heat-resisting rubber—and Pima Cotton, the longest cotton fibre grown.

THE GOODYEAR TIRE & RUBBER COMPANY, INC.
AKRON, OHIO

***EXTRA STRONG BEAD CONSTRUCTION**

To provide strength for heavy loads, swaying loads, high loads, Goodyear truck tires have an extra-strong, heavy, braided-wire bead—wide and securely tied in by the plies of the tire. This construction insures a firm seating of tire on rim. The larger size truck tires have dual beads.

GOODYEAR TRUCK TIRES money savers

Don't forget the READERS' SERVICE DEPT.—pages 51-53.

Determining the Effects of Chlorine on Sewage

THE use of chlorine gas for sewage treatment was patented more than 75 years ago, and sewage chlorination has been practiced for a number of years, but many of the factors affecting the efficiency of chlorine and the behavior of chlorine and chlorine products in the presence of organic and inorganic materials which occur in sewage are not clearly understood. With a view to remedying, in part at least, this insufficiency of knowledge, an investigation by laboratory experimentation has been conducted by the New Jersey Agricultural Experiment Station. This dealt with the chlorine consumption of sewage, the effect of chlorine on the flora and fauna, and on oxidation, and the effect of some physical and chemical factors on the bactericidal action of chlorine. A brief abstract of the findings follows.

Amount of Chlorine Absorbed

When sewage is chlorinated, the amount of chlorine absorbed by the living and dead bacteria is so small that it can not be measured by methods commonly employed. With complete chlorination, the settleable and soluble substances each consumed about 25% and the non-settleable about 50%; but on the basis of weight the finely divided material (colloidal and pseudo-colloidal) consumed about 65%, the non-settleable solids about 30%, and the settleable together with the soluble substances only 5% of the chlorine added.

The turbidity of settled sewage and of activated sludge increased upon chlorination. Portions of the dispersed materials became soluble, and the fraction made soluble consisted of nitrogenous substances.

Of the several methods tried to determine residual chlorine, a slightly modified ortho-tolidine test gave consistent results.

Effect on Bacteria

Bacterial removal (*B. coli* and 20° C. count) from sewage varied with the quantity of chlorine added, the contact time employed, and the types of substances present. The reduction in numbers of organisms, both *B. coli* and total bacteria, was followed by great increase after continuous incubation. In all cases, except when 100% of the chlorine demand was satisfied, growth increased in 6 hours after chlorination but none reached the original numbers until after 24 hours of incubation. The aftergrowth was not directly proportional to the quantities of chlorine added. Microscopic examination of the sewage showed that with 50 to 75 per cent of the chlorine demand satisfied, the fauna was reduced to such an extent that no protozoa were present after 72 hours' incubation. The greater the initial reduction of bacteria the longer the lag, followed by a more rapid increase. The aftergrowth showed a predominance of the pseudomonas pigment-forming bacteria, indicating a selective action of the chlorine. A description of the chlorine-resistant organisms is given.

Split chlorination kills as many bacteria with the same quantity of chlorine as does addition in a single dose, but chlorine consumption is about 7 per cent higher when chlorine is added in successive doses. Adding chlorinated sewage to unchlorinated sewage reduces the bacterial numbers in proportion to the final dosage of chlorine. These results indicate that by pre- and split chlorination the greatest use is made of the chlorine added.

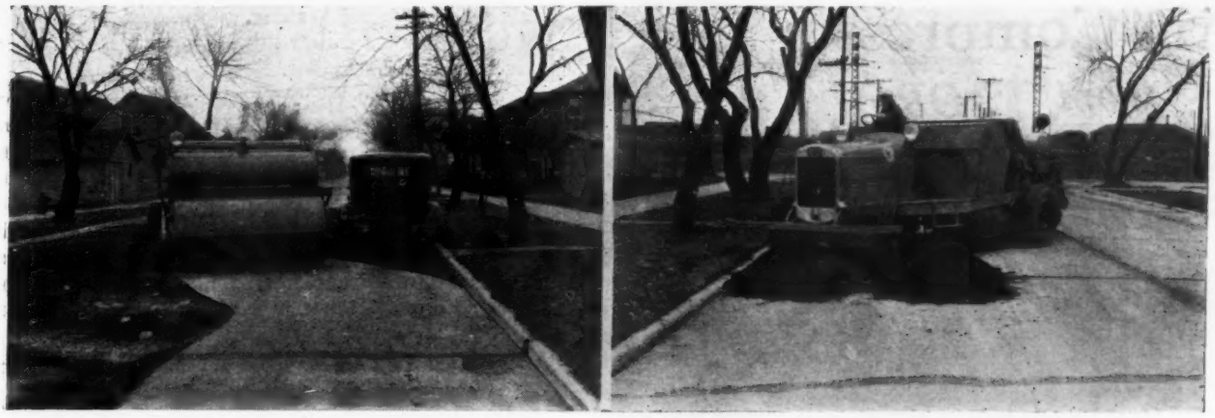
Within the limits of 5° to 37 C., neither bacterial reduction nor chlorine demand was appreciably affected by temperature in fresh or stale sewage. Increasing the speed and the time of mixing chlorine with sewage does not result in greater kill. Penetration of the chlorine with proper mixing is very rapid, and a single thorough mixing is all that is necessary to obtain maximum bacterial removal in up to 10 minutes' contact time. Hydrogen sulfide present in sewage may interfere to some extent with bacterial removal but other substances produced during decomposition, which are usually present in stale sewage or settling tank effluents, are of greater importance. The same quantity of chlorine added to sewage but varying in strength from 100 to 1,070 p.p.m. did not cause any difference in the bacterial kill. In plant practice the concentration varies widely, depending upon the chlorine demand and the quantity of sewage as well as upon the type of chlorinator used. Maximum bacterial kill can be obtained, therefore, with any type of chlorinator or any strength of chlorine, provided good mixing is allowed, and chlorine consumption can be reduced by control.

Chlorine and B. O. D.

The effect of chlorine upon B.O.D. reduction of carbon oxidation showed that when regular 5-day B.O.D. determinations are made the B.O.D. will be lower when a contact time of only 10 minutes is allowed with chlorine and the same type and quantity of such material are used. The effect of the chloro-products formed does not seem to extend beyond the first 6 days of incubation. Partial chlorination of sewage lagged behind unchlorinated sewage but was persistently greater than the sewages chlorinated to 100 per cent of the demand. The 5-day B.O.D. reduction in 42 samples of different sewages was 2.4 p.p.m. for each part per million chlorine added, while samples of very stale sewage showed an average reduction of 2.6 p.p.m. B.O.D. for each part per million chlorine added. With shorter and longer incubation periods the B.O.D. reduction was less or more, depending upon the incubation time. The reduction of B.O.D. depends upon the quantity of chlorine added, but the total B.O.D. reduction is practically constant with quantities of chlorine added as low as 20 per cent of the demand; consequently, the more chlorine is added the less apparent B.O.D. is removed when calculated in parts per million B.O.D. reduction for each part per million chlorine added. The results are correlated with the effect of chlorine upon the soluble and semi-soluble material.

During the first 5 days of incubation less carbon was oxidized from the chlorinated sewage than from the unchlorinated, but after 10 days' incubation the quantities of carbon oxidized were the same. Corresponding bacterial results explain the initial retardation and the following rapid rise in activity of the chlorinated sewages.

The experiments from which the above conclusions were drawn have been described in full in Bulletin 601 of the New Jersey Agricultural Experiment Station.



At the left, the illustration shows how closely a modern sweeper can pass a parked automobile; at the right, dumping a load.

Modern Street Cleaning and Its Economy

TODAY there are really only two methods of street cleaning generally in use; one method is to move the dirt into the gutter and collect this rubbish by manual labor; and the second is through the use of motorized street sweepers, which not only sweep the streets but are able to carry off the rubbish to the municipal dump.

One method includes the white wings with his broom and shovel—once the last word in civic progress. Allied with his efforts is the sprinkling cart, now motorized and modernized as a street flusher but operating on approximately the same principle as its horse drawn predecessor; that is, to wash the refuse into the gutter where it may be swept up by hand. If a community has the money to afford such a method, the results of this system, though expensive, allow the city to "get by," but this work that never ends is seldom more than half done since the burden on the taxpayer eliminates the chance of covering any more than the business district regardless of the size of the community or the wealth of its citizens.

A department chief who is planning to make improvements in the efficiency of his street cleaning service will find it difficult, if not impossible, to base his estimates of cost of hand labor versus machine operation on anything but his own costs, since there are too many variable elements which must be taken into consideration before a logical comparison can be made. Small towns of six thousand or less seldom have an established department for this purpose alone. In larger cities the cost of labor, the conditions of climate, the thoroughness with which the men do their work, are all factors.

A Fair Comparison of Costs

If we set up our comparison on the theory that the laborer must do as complete a job as the machine, then including every possible item of cost the motor sweeper wins the comparison hands down, for it does its job faster and the swept pavement it leaves behind is as clean as a Dutchman's doorstep. If, on the other hand, we compare the desultory efforts of the average white wing who sweeps up a foot or two of gutter at the street intersections and cleans here and there along the block, the cost differential in favor of the motor sweeper is heavily reduced.

For this reason alone, though there are many others, the individual or department in charge should determine exactly what is wanted in the way of clean streets and use this as the basis for comparison. This is why the following data, though generally correct, cannot be strictly applied to an individual problem but indicates a method of procedure which may prove useful.

A modern truck type motor sweeper driven by any operator with experience in driving an automobile can cover a maximum of thirty miles per eight-hour day. In large cities, like Los Angeles, where traffic shifts heavily from business centers to suburbs at different hours, a sweeper operated twenty-four hours a day would cover ninety gutter miles per day, sweeping forty-five miles of streets on both sides in twenty-four hours. The term gutter mile is used to distinguish the difference between cleaning one mile of gutter and one mile of street, which of course has two gutters and therefore has two gutter miles.

In an average community, however, where the population is from 7,000 to 25,000 and the paved street mileage is from a minimum of twenty miles to as high as one hundred miles, a motor sweeper is generally operated from eight to twelve hours out of the twenty-four.

Use in the Average City

For the sake of illustration, let us take as typical a certain suburban village of Illinois, with a population of 7,000 and a total of approximately sixty-four paved street miles. This community has never used hand labor for street cleaning, but it is clear from records in other nearby communities that a laborer performing white wing work by hand can clean two gutter miles per eight hour day, assuming that he does a sweeping job. If he is aided by a truck sprinkler and has only to sweep up gutter refuse, his speed will be higher, yet the additional truck sprinkling equipment would have to be included in his cost of operation. Assuming then, that he is doing the entire sweeping job and that he is cleaning a five foot width along the gutter as against a motor pickup sweeper's nine feet, the estimate of two miles per day appears reasonable, providing the disposal of the rubbish he collects is taken care of by a rubbish collector who makes the rounds in a truck.

On the basis of fifty cents an hour for this work the

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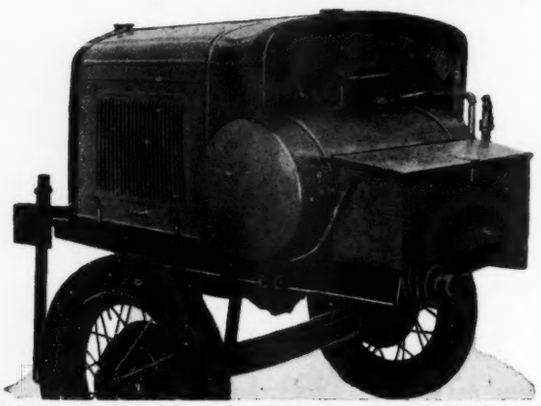

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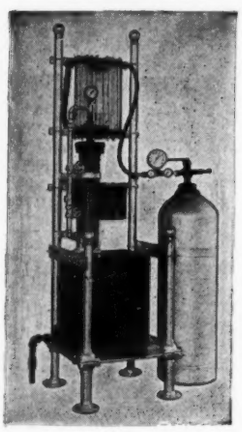

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laborer receives $4 per day, or $22 per week. The cost of cleaning each gutter mile of streets is therefore $2 per mile for hand labor.

Records on the cost of a motor sweeper in this community, in which the purchase price of the motor sweeper is depreciated over a five-year period, show that the cost per gutter mile including fuel, lubrication, driver's salary, maintenance, and depreciation are fifty cents per mile; the number of gutter miles covered per eight-hour day is twenty-six, or thirteen miles of streets cleaned completely. This is equivalent to the work of thirteen laborers working the same number of hours at a cost of $52.

Naturally in this northern community the number of working days is reduced by winter weather. The machine goes into operation as soon as the last snows are off the streets, clearing the sand and cinders that have been spread on icy pavements and the accumulation of rubbish which winter always leaves behind, and it is kept in operation until the first heavy snow fall, doing needed service during the autumn months in keeping the catch basins and gutters free of leaves. The total number of days of operation in a year amount to about two hundred. On this basis the total number of gutter miles cleaned per year is 5,200 and the total annual cost is $2,600. For the same number of gutter miles to be cleaned by hand labor the cost per mile would amount to $10,400, showing a saving due to motor sweeper operation of $7,800 per year.

As already pointed out, the equipment is depreciated over a five-year period included in the cost of operation, with the result that this saving over hand labor is available for other public works projects or for tax reduction.

Turning this saving into jobs for men who are on relief and who need work in the community, of the twelve men who are theoretically replaced by this machine, ten could be employed on permanent public works improvement, using the money savings made possible by this machine. This leaves only two men to find a new job in the community during the two hundred days when the motor sweeper is in operation on the streets.

Actually, however, this loss of jobs seldom occurs since, as already shown, no city, whatever its wealth, can afford the high cost of manual street sweeping on all of its streets and the purchase of motor pickup sweepers generally means an expansion of street cleaning service, giving the taxpayers in the outlying areas an extra service which formerly could be supplied only to the business and commercial sections of the city or town.

Several items of cost have not been included here because they are never twice the same. The cost of cleaning catch basins has not been mentioned, but in Bedford, Indiana, a city with 13,000 population, where records have been kept, it has been shown that motor sweepers cut cost of catch basin cleaning as much as $1,000 per year. The cost of rubbish removal is also excluded since in many towns the rubbish is removed by the sweeper itself to the city dump.

But regardless of whether motorized sweepers are purchased to reduce costs or to improve the services of the community, the results in appearance and cleanliness are noticeable at once. The protection of foodstuffs and merchandise from dust, and the added protection of health, though intangibles, are factors which add their weight as further reasons for the use of this type of equipment.

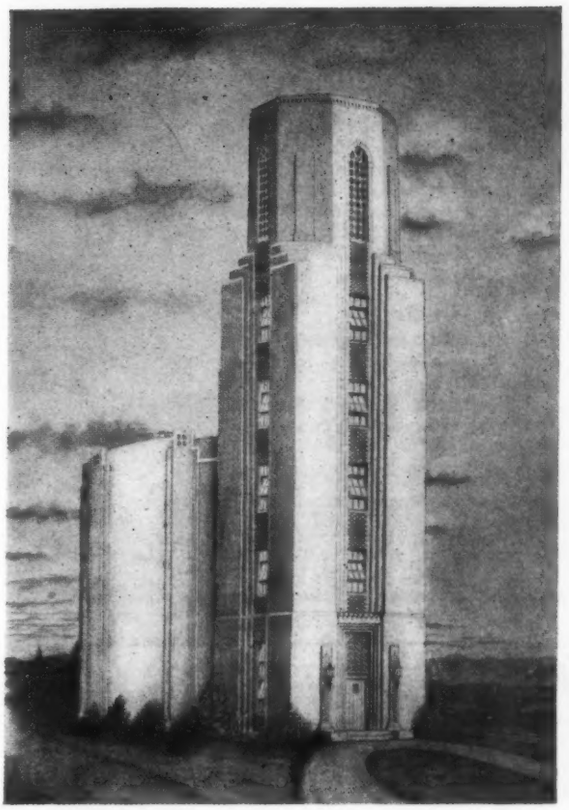
Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

An **automatic softening** and iron removal plant at East Lansing, Mich., is believed to be "the most completely automatically operated municipal water treatment plant in the United States." There is no operator on duty at any time, although the plant is inspected regularly. It is a pressure plant and water is pumped through it from well head to distribution system. The capacity is 1 mgd, ¾ of which is softened by passing through five greensand zeolite softening units and ¼ through two manganese zeolite filters which remove iron by oxidation and filtration; the two waters being mixed to form one from which ¾ of the softness and all the iron has been removed. The mixed flow is treated with a solution of caustic soda and sodium silicate. Automatic operation is simplified by the uniform rate of pumping to equalizing storage tanks. An electric sequence time switch initiates the automatic regenerations of the softeners, each of which is equipped with a motor-operated multiport valve, and the unit softens water for a predetermined time, backwashes for 10 min., then pumps the fixed amount of brine through the filter, then rinses out the salt water, then returns to the softening position — all automatically, over and over continuously. The plant cost $21,000 complete. Treatment cost (including 7½% fixed charges) 5.65 cts. per 1,000 gallons.[G16]

A **tower filter plant** is to be built at Lexington, Va., in order that the filtered water may flow by gravity into the existing distribution reservoir. The building consists of a square tower 100 ft. high, connected to a circular filter structure 50 ft. high. The first floor of the tower is the entrance lobby, with space for meters; 2nd floor, chlorinator floor and laboratory; 3rd floor, valve gallery; 4th floor, filter operating floor; 5th floor, chemical feeders and storage; above this, the wash-water tank. In the filter building, on the top floor the coagulant chemical is applied to the water, mixed and flocculated, drops about 35′ to the bottom of the coagulation basin which occupies the bottom 26′ of the building, passes through baffles in this, and rises onto the gravity filter beds which, together with the mixing basins, rest on the roof of the coagulation basin and are enclosed in a glass structure.[G12]

An intake for the Montreal water works is recommended by a board of engineers, to consist of four lines of pipe with a combined capacity of 200 mgd extending to a point 2200 ft. from the shore, estimated to cost about $1,709,000. At present there are two intakes, one at the shore where the water is highly contaminated; the other 1200 ft. from shore, where there frequently is an "undesirable" amount of contamination, the capacity only 80 mgd while the peak consumption has reached 174 mgd., and frazil ice gives trouble, necessitating use of the shore inlet much of the time. "The only alternative would be to install coagulating basins at a cost of $2,400,000" (the filter plant contains no such basins) "and to operate them at an annual cost of around $400,000." It is not considered probable that the city's average daily consumption will reach 200 mgd for some years to come, as leakage surveys and repairs will reduce consumption, and contemplated storage reservoirs will reduce peaks.[M29]



New filter plant for Lexington, Va.

Dewatering mains by use of compressed air has been successful at Danvers, Mass. A fire hydrant is opened at the lowest part of the stretch to be emptied and an air compressor connected to the highest part and air forced into the pipe until it comes out of the hydrant. In one case 1,000 ft. of 8″ and 5,000 ft. of 6″ pipe forming a dead end were emptied in 35 min.; seven cuts were made in the line for inserting gates and hydrants and six of these were completely dry and in the seventh the trench became only damp. If there is a high point beyond the blow-off hydrant, stop the air compressor to let the water from here run down to the blow-off, turn on the air again, and repeat this several times.[G18]

Drill holes at the site of Couchas dam (New Mexico) were carried to a depth of nearly 200 ft. and some cores 30″ in diameter were taken. "In order to permit more detailed examination of the foundation rock, use was made of periscope observations in special holes 8″ in diameter; also direct observations were made in

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holes 30" in diameter. Only a few of the latter size were drilled. Much thought has been given to preserving drill core records for future reference. Photography has been of considerable assistance. Soon after the cores are brought to the field office and before they are handled for examination and identification, the core boxes and their contents are photographed. . . . Photography, in an experimental way, has been applied to the interior of the larger drill holes with the aid of 16mm motion picture film. The object here is to preserve a visual record of the rock and the nature and position of all seams and partings."[L2]

Snow surveys have been established as regular procedure in the mountainous areas of the Missouri river basin above Fort Peck dam to aid in predicting the run-off. Twelve snow-survey courses have been established, and 25 temperature and precipitation stations selected with careful consideration to location and altitude. Data from these stations are available for a period of 25 years, but snow survey data cover only two seasons (1934-1935); in spite of which an estimate made in March, 1935, of the probable April-July run-off was within 6% of that which occurred. "The results obtained up to the present time with snow surveys in the upper Missouri basin have been most encouraging. It is anticipated that the reliability of the forecast will improve with added experience and with each additional year that snow survey data are secured. It would be desirable to expand the snow survey program in the Missouri river basin to include the headwaters of the Yellowstone and Cheyenne rivers, for these streams will produce the greater portion of the flow of the Missouri river at Yankton during storage periods at the Fort Peck reservoir." [E10]

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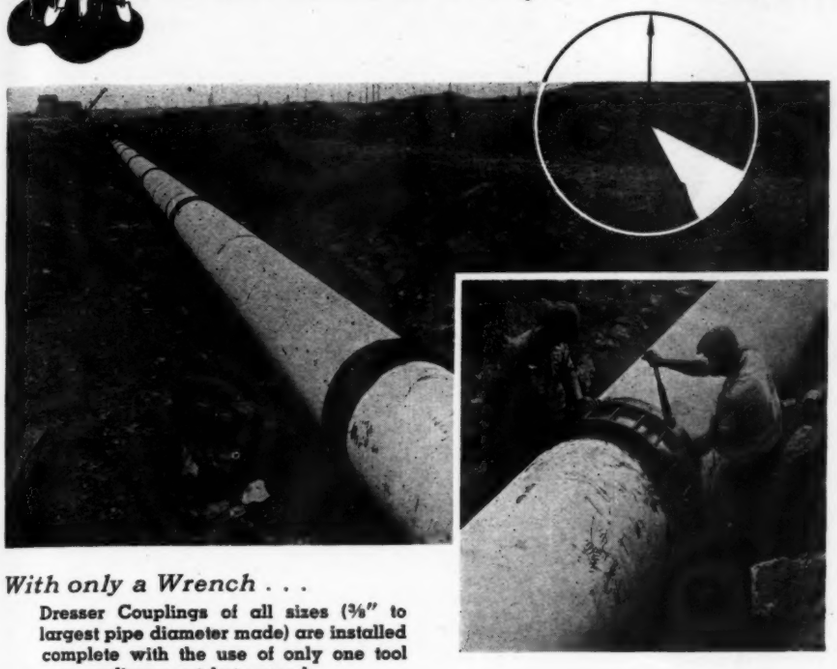

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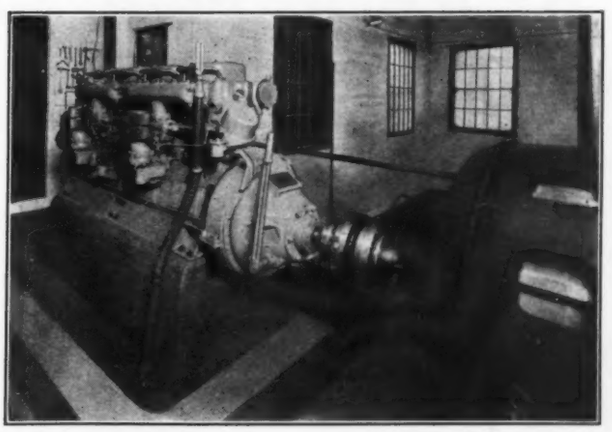

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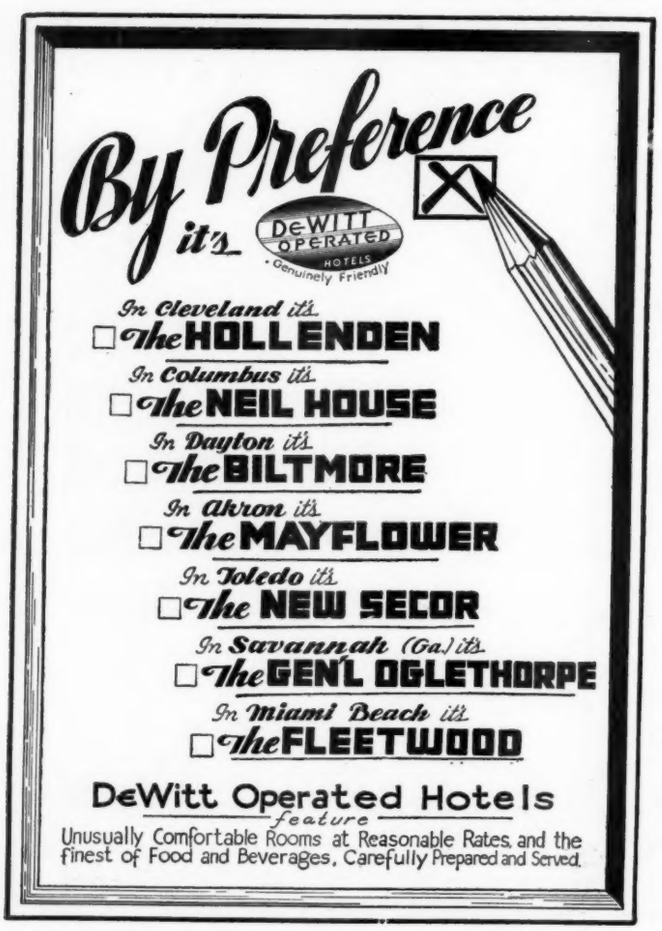

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39. Trends in Tanks. By R. H. Beck, pp. 820-822.
40. *p.* Handling Routine Problems. By F. J. Broz, pp. 823-825.
41. Principles Underlying the Chemistry of Water Purification. By C. R. Cox, pp. 829-831.
42. *p.* Treatment of Swimming Pool Water to Insure Purity of Supply. By R. F. Heath, pp. 855, 856, 859.
43. Arc Welding Sets Prove Cheapest for Thawing Frozen Services and Mains. By P. R. McNutt, pp. 859-860.
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47. *p.* Making the Filter Do More Work. By H. N. Jenks, pp. 895-898.
48. Hydrogen Ion Concentration. By C. R. Cox, pp. 899-902.
49. *p.* Importance of Stream Flow Measurements to Water Works. By J. J. Dirzulaitis, pp. 911, 916.

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16. Automatic Softening and Iron Removal Plant at East Lansing, Mich. By F. R. Theroux, pp. 186-188.
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3. Developments in Water Works Construction. By C. B. Burdick, pp. 449-453.

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23. *p.* Filter Design as Related to Operation. By H. N. Jenks, pp. 9-12.
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27. Electric Thawing of Water Services, pp. 8-9.
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29. *n.* Engineers' Report on Proposed Intake at Montreal, p. 13.

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2. Methods of Testing and Measuring the Yield of Wells, pp. 1-8.
3. The Wisconsin State Well Drilling Sanitary Code, pp. 14-23.

Los Angeles Garbage

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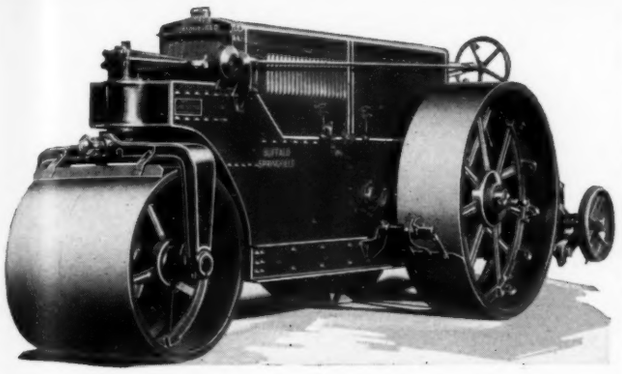

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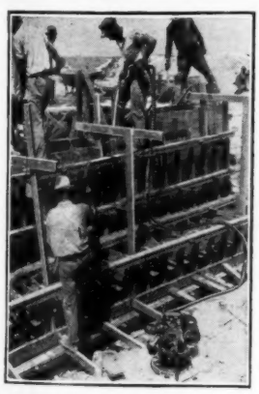

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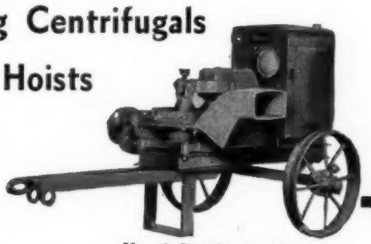

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Don't forget the READERS' SERVICE DEPT.—pages 51-53.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

Exeter (England) sewage treatment, replacing the original Cameron septic tanks, consists of 3 detritus tanks, rack screens with 3" spacing, mechanically cleaned screens with ¾" spacing; 16 preliminary settling tanks, Dortmund type; 8 aeration tanks, with Simplex surface aerators and adjustable outlet veins to vary submergence of cones and therefore amount of aeration; capacity giving 16 hrs. retention of dry-weather flow; 8 final settling tanks, Dortmund type, capacity 6.22 hrs. of dry-weather flow; 2 primary and 3 secondary digestion tanks; and 64 sludge drying beds with area of ¼ sq. yd. per capita. Each primary digestion tank receives sludge twice a week; "there is no doubt that for best operating conditions this brief spell between sludge additions to the tanks is desirable. Sludge from the secondary tanks is pumped into the main along with the raw sludge for seeding purposes, about 25% by volume being used."[D29]

House refuse composting with sewage sludge is being tried in England under the name of the "Maidenhead process." Ashes are screened from the refuse, the tailings picked over on a belt, the rest (including tin cans) pulverized, and the tin removed by a magnetic separator. The pulverized material is spread on the bottom of sludge drying beds and the sewage sludge drawn onto it. "Within two days these beds will be turned over by hand or machine, with the result that the mixture will generate a temperature up to 170° F. The evaporation of the wet sludge . . . is intensive and continuous, two turns of the mixture resulting in the complete evaporation of the water, and at this stage aerobic digestion takes place. Within fourteen days, if required, the mixture or compost can be opened up and fresh and additional sludge applied, and the process repeated." Seeds and noxious germs are destroyed without nuisance, and a convenient fertilizer produced "containing more nitrogen, phosphates, potash and lime than an equal weight of stable manure." Leatherhead intends to adopt this process and has a 7-year agreement with a firm of "agricultural contractors" for removing it.[D27]

Bulking prevention and reduction of aeration and odor were the subjects of investigation at the Hagerstown, Md., activated sludge plant, using chlorinated copperas. Plant-scale experiments showed that chlorinated copperas with excess chlorine (but not without) added to returned sludge prevented bulking, a dose of 3.6 ppm ferric iron proving adequate. This also reduced air requirements by about one half, detention time was decreased and odors were entirely absent. Also, somewhat less amounts of ferric chloride appear to have been required for conditioning sludge prior to vacuum filtration.[G13]

Constructing outfall in unstable river silt in Winnipeg was effected by use of 495 ft. of corrugated pure iron pipe 7' 6" diameter, six plates to a ring, fastened with "Z-metal" bolts and fully coated with a special asphaltic material because of corrosive soil. An alternative design called for a manhole down to hardpan 55 ft. below the surface and 40 ft. below river level, 680 ft. of concrete sewer, and an outlet manhole rising into the river channel; but the bids for this were $57,800 (considered too low) and $85,000, while the corrugated pipe was built for $32,625. When tested for tightness, with the outer end bulkheaded and the river higher than the top of the pipe, there was only a slight seepage.[M4]

Pre-settling prior to coagulation may be beneficial when the sewage contains large quantities of settleable solids, but otherwise when the sewage is weak and its pH value adjusted to the alkaline range of optimum coagulation. However, in the latter case, pre-settling would not be detrimental to coagulation when bulky chemical sludge is returned to the influent. The initial settling rates of completely clarified sewage were somewhat less for pre-settled sewage, while no effect of solids concentration was noticed with partially clarified sewage.[C16]

Sulfite waste from pulp mills is enormous in amount—about a ton for every ton of pulp produced, carrying 100,000 ppm or more of dissolved solids, and a B.O.D. of about 20,000 ppm. "At the present time there is no known process for the treatment of sulfite waste which will produce an effluent comparable to that from domestic sewage in modern plants 'although' more than 1,500 patents have been issued for the recovery and utilization of the waste liquor."

If chemicals are used, it takes enormous quantities; more practicable seems to be supplying oxygen. Ponding and aeration have reduced the O.D. 76% to 92%; mechanical aeration, as by spraying, 34% to 60%. Ponding also prevents intense periodic pollution. Uses suggested for recovered sulfite liquor include manufacture of binding, adhesive and sizing materials, tanning, alcohol and yeast; but low adhesiveness and color militate against all but the last two, and these are not profitable; and they could not absorb more than a small fraction of the liquor available. "The best opportunities seem to be utilization as cattle fodder, fertilizer, and fuel, considering the need for economy and the large quantities of liquor produced."[L2]

Milk wastes are treated more successfully by aerobic than by anaerobic methods. "I believe that sufficient data have been gathered at various plants throughout the United States to warrant the statement that the trickling filter is one of the most satisfactory ways to treat milk wastes.

"Studies that have been made indicate that best results with sprinkling filters are obtained: (a) When cinders or stone from 1½ to 3 in. are used as the filter material. (b) When the depth of the filters is from 5 to 9 ft. with a depth of 6 to 8 ft. most common. (c) With waste applied at rates varying from 500,000 to 1,000,000 gal. per acre per day over a period of 10 to 14 hours. Kimberly in the Ohio work tentatively suggests 80 cu. ft. of filter space per pound of milk solids to be treated daily. (d) When the waste is applied frequently in small doses rather than less frequently and in larger doses, the reduction in B.O.D. seemingly varies in-

versely with the duration of dosing cycle, and is greater for a dosing cycle of 7 min. than for one of 20 to 25 min. (e) With filters constructed so as to be ventilated at the bottom and allowing for circulation of air through the filter."[24]

Bibliography of Recent Sewerage Literature

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D — *The Surveyor*

June 26

27. *p.* Sewerage and Sewage Disposal in a Newly Constituted Urban Area. By J. L. Davies, pp. 873-876.

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28. Provision of Public Sewers, pp. 3-4.
29. *p.* Sewage Disposal at Exeter. By W. H. Hoyle, pp. 7-9.
30. Leicester's Sewage Works, p. 10.
31. *p.* Further Purification by Bacterial Filters of Effluent from a Partial Treatment Activated Sludge Plant. By A. S. Miller, pp. 11-12.

E — *Engineering News-Record*

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13. *p.* Surveying Sewage Pollution in Shell Fish Producing Waters. By A. P. Miller, pp. 49-50.

G — *Water Works and Sewerage*

June

13. Effect of Iron and Chlorine on Activated Sludge Bulking. By H. E. Rhodes, pp. 196-199.
14. Centrifugal Dewatering of Sludges. By P. B. Streander, pp. 212-217.
15. Treatment of Combined Domestic and Industrial Sewage in Mechanical Aeration Plant. By H. R. Green, pp. 218-220.

H — *Municipal Sanitation*

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18. Selecting Motors and Control for Sewage Works. By V. B. Miller, pp. 232-234, 238.
19. Laboratory Control of Sewage Treatment. By F. W. Gilcreas, pp. 235-238.
20. *n.* Schenectady Sewage Works Sells Its Sludge Fertilizer, p. 238.
21. Anthracite in Sewage Treatment. By H. G. Turner, pp. 239-240, 250.
22. Status of Sewage and Industrial Waste Disposal in the U. S. By G. H. Hazlehurst and F. C. Roberts, Jr.

J — *American City*

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2. Sewage Treatment at Sioux Falls. By J. B. Estabrook, pp. 47-49.
3. Selecting a Method of Sludge Disposal. By N. T. Veatch, Jr., pp. 55-56.
4. Financing Sewerage Service Outside City Limits, p. 71.

L — *Civil Engineering*

July

3. The Hot Springs Sewage Treatment Plants. By E. L. Filby, pp. 453-456.

M — *Canadian Engineer*

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4. Winnipeg Outfall Sewer. By D. L. McLean, pp. 5-7, 14.

P — *Public Works*

July

21. The Municipality's Problem of Human Wastes. By G. H. Hazlehurst, p. 14.
22. *c.* Failed Sewer in Rochester Replaced Without Delaying Traffic. By E. M. Van Gelder, p. 18.
23. Treating Creamery Wastes on Trickling Filters, pp. 23-24.
24. *n.* Distillery Wastes, p. 24.
25. *n.* A Year's Sludge Incineration at Dearborn, p. 42.

T — *Technique Sanitaire et Municipale*

May

3. Note sur le calcul des eaux d'egouts. By M. Bertharion, pp. 103-110.

Treating Swimming Pool Water in New South Wales

Essential requirements for ensuring the purity of water in swimming pools as drawn up by the New South Wales local government department are as follows: Turbidity shall not exceed 5 p.p.m., color not to exceed 5 p.p.m., no detectable odor, alkalinity to be maintained within limits of pH range 6.5—8.5. Treatment required: Chlorination with residual to be maintained between 0.1 and 0.5 p.p.m. at all times. Turnover rate: 3 times per 24 hours. System should include filtration plant, pumping plant, screens, piping system and meter, suction cleaner, and heater (if specified). Filtration rate not to exceed 180 gal./ sq. ft./hr. Bathing load: no more than 20 persons for each 1000 gal. of filtered water added or returned to pool. Details regarding sand and gravel to be used in filters, filter washing, types of pumps, motors, etc., are also given.

The above summary is from an article in the Commonwealth Engineer, as reproduced in Public Health Engineering Abstracts.

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The Need and Demand for Snow Removal

LAST winter the editor of this magazine wrote to a number of state, city and county engineers, asking them about the demand for snow removal work in their respective areas. One purpose behind this request was to get this reaction at the very time when snow conditions were severe. However, when snow has fallen and must be removed, it is generally too late to change the plans; often it is too late to get needed equipment. Such planning and such equipment must be arranged for well in advance of the snow season. While hot weather will prevail for some time after this issue reaches our readers, even those who reside in the most northern states, it is time to prepare for snow removal.

Herewith are statements by several of our readers on the demand and the need for snow removal. Further articles on this general subject of snow removal will appear in succeeding issues.

Hartford, Conn.

The demand is pronounced for plowing of all streets in our city. The schedule now calls for plowing all that are at all usable, about 180 miles. The entire removal of snow extends over about 20 miles. The city charter obligates abutting owners or tenants to clear sidewalks; the city does no sidewalk plowing other than park walks. Abutting owners are required to clear walks within two hours after the storm ceases unless the storm ends in the night, then three hours after sunrise. *Leon F. Peck, Superintendent of Streets.*

Ohio Department of Highways

We have found that the demand for snow removal is increasing annually; that the public is becoming more exacting in its demands on us. We have been asked to help in removing snow and ice on our secondary highways; however owing to our laws in this state we are required to confine our activities to the 12,000 miles on our system. Small municipalities and villages along our highways, which under the law, we are not required to maintain, nevertheless are kept free from snow on the state routes just as if they were part of our regular system. The inhabitants of these villages seem to be deeply appreciative of the work we do in this connection. *Carl G. Wahl, Assistant Director of Highways.*

Summit County, Ohio

We have been asked by residents to extend the scope of snow removal to local roads and our policy is to plow all of the roads that have been improved. We of course take care of the main routes first and the secondary ones as quickly as possible. We are called upon sometimes to clear some of the unimproved roads but this is usually limited to taking care of some drifted sections and the most of this work is passed on to the township trustees. County mileage has recently been extended and we will have approximately 250 miles to keep clear during the coming winter. There is no question in my judgment but what this problem is one which will become greater rather than lessened. *Hal G. Sours, County Surveyor.*

Scott County, Iowa

We are requested by residents along the roads to have snow removed, and this we try to do. Snow removal pays; it keeps roads open for traffic; prevents mudholes in the Spring and lowers maintenance costs. It is hard to estimate the return in dollars and cents.

Tie-ups like the one shown at the left emphasize the need for modern equipment, as shown at the right and at the top of the page.

Scott county has approximately 145 miles of oiled earth roads. Snow is the most destructive factor on this type of road so we endeavor to remove all the snow possible from oiled roads. Slippery and icy roads give us some trouble at certain times of the year, especially on oiled roads and sometimes on gravel roads. We have not had any serious accidents due to this cause, and we have used very little sand. We use the following equipment for snow removal: 1 large LaPlant-Choate snow plow with hydraulic lift wings attached to a "60" caterpillar tractor; 2 speed plows attached to 3-ton Mack trucks; 2 one-way plows on small trucks; 2 V-type plows on maintainers. In addition we use 9 maintainers for removing light snow and pushing heavy snow in the ditches where possible. *J. M. Malloy, County Engineer.*

Oregon State Highway Commission

We have many requests for snow removal on county roads, but we are prohibited by law from spending state funds on roads not included in the state highway system; therefore, it is necessary to deny these requests. *R. H. Baldock, State Highway Engineer.*

Richland County, Ohio

All residents along state, county and township roads are very forceful in demands for instant snow removal. Approximately 450 miles of county roads have been kept open through this office. *Howard C. Swords, County Engineer.*

California Division of Highways

Each season, there are requests to keep additional mileage of our routes open, particularly in the recreational areas. However, this work depends, in a measure, on the degree of improvement of the road as heavy equipment cannot be operated over steep and narrow roads to any advantage, nor over roads which have not been surfaced. *T. H. Dennis, Maintenance Engineer.*

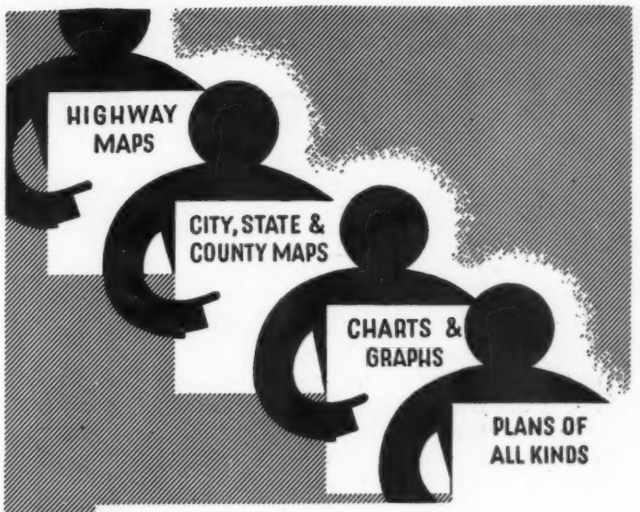
Springfield, Mass.

Each winter we extend the scope of our snow plowing and snow removal operations to include any new thoroughfares constructed during the previous year. We do not plow sidewalks, with the exception of those walks bordering on public-owned buildings.

No request for sidewalk plowing by the municipality has been made by our citizens. This service has not heretofore been extended and, as a consequence, we are unable to say what the reaction of the public would be to a program of this nature. That it would be favorable I have no doubt and perhaps sidewalk plowing may be added to our already extensive snow clearing operations at some future date, when the burden of taxation will be more easy to bear.

Our street plowing usually begins when three or four inches of snow has fallen and is continued night or day until all streets are entirely cleared. We also remove and dispose of all snow thrown to the sides by plowing and give special attention to keeping all gutters, catch basins, curb inlets, etc., free from obstruction, so that surface water caused by melting snow or from any other source may quickly drain off.

When the magnitude of snow fall warrants the sending out of our snow plowing equipment, which is before traffic is seriously impeded, our snow fighting forces are continuously at work, so that at no time is business greatly inconvenienced. This holds good for storms occurring at night, and Springfield invariably awakes to find its streets cleared of any accumulated snow. *Cornelius W. Phillips, Superintendent of Streets and Engineering.*



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Don't forget the READERS' SERVICE DEPT.—pages 51-53.

Laboratory Studies of the Chemical Precipitation of Sewage

By EDGAR WHEDBEE and P. J. ALWIN ZELLER
Texas Engineering Experiment Station

STUDIES covering a period of one year were conducted on the coagulation of the sewage of Dallas, Texas. The coagulants used included ferric chloride, aluminum chloride, alum, ferric sulfate, copperas, sodium aluminate and calcium chloride. Coagulation was tried over a pH range from 3 to 13, adjustments being made with suitable quantities of sulfuric acid, lime or caustic soda. The effect of oxidizing reagents, aeration and combinations of coagulants was included. The work was carried on by the authors, and the complete reports on the work has been issued as Bulletin No. 44 of the Texas Agricultural and Mechanical College.

Dallas is an industrial city and its sewage reflects this. The major industries include cottonseed oil mills, metal working shops, petroleum refineries and several meat packing houses. The sewage is strong and highly variable. The BOD average is 370 ppm, and the suspended solids about 510, with occasional higher concentrations. The sewage used was fairly representative of daytime conditions. The results of the various tests, which are given in full in Bulletin 44, are summarized below.

Ferric Chloride

Summing up the experiences with a large number of tests using ferric chloride as a coagulant, the investigators reported:

1. Coagulation by means of 4 gpg ferric chloride is possible without hydrion control. The results achieved will be decidedly superior to plain settling.
2. Coagulation with hydrion control on the alkaline side does not improve the results obtained. As the hydrions are depressed further from the neutral point, the results become poorer.
3. Coagulation with hydrion control on the acid side offers distinct advantages.
4. Control with acid to the vicinity of pH 5.5, and 2.0 to 2.5 gpg ferric chloride, resulted in 90 to 95 per cent removal of SS, and 80 per cent removal of OC and BOD.
5. Fresh ferric chloride free from ferrous is essential to the success of the process and to accurate dosage.
6. An air blast does not improve coagulation appreciably.
7. Small doses of permanganate improve coagulation.
8. Return of sludge improves coagulation and removals.
9. Chlorine is not practicable as a hydrion control agent.
10. Coagulation of settled sewage does not produce an effluent superior to coagulated raw sewage.

Aluminum Chloride

Using $AlCl_3$, the following conclusions regarding the chemical were reached:

1. Proper coagulation can be secured over a wide range from 5.5 to 9.0 pH.
2. Without hydrion control, 10 gpg $AlCl_3$ will be required.
3. With lime control, the correct dose is approximately 5 gpg.
4. With acid control, 2.5 to 5.0 gpg will effect coagulation.
5. Acid control is generally to be preferred to lime control, but this will depend upon local conditions.
6. Removals to be expected are as follows: SS, 85 to 95 per cent; OC, 50 to 90 per cent; and BOD, 60 to 76 per cent.

Filter Alum

Filter alum, used very largely in waterworks practice, was also tried out. Following is a summary of results:

1. Filter alum will coagulate sewage satisfactorily over a range from 6.0 to 8.5 pH.
2. At least 80 per cent of SS and 60 per cent or better of OC and BOD will be removed.
3. The required dosage is 5 to 6 gpg alum and 15 gpg sulfuric acid to 7.5 gpg lime.
4. Coagulation on the alkaline side is more practicable in view of the smaller dosages required.

Ferric Sulfate

Summing up the ferric sulfate precipitation of sewage, the investigators found:

1. Ferric sulfate will coagulate sewage without hydrion control.
2. A saving results from adjustment of hydrions to 8.0 or 8.5 pH with lime.
3. Controlled coagulation can be effected by 2.5 gpg ferric sulfate, and 4.0 gpg acid, or 10.0 gpg lime.
4. Controlled coagulation will remove 80 per cent of SS, and 60 per cent each of OC and BOD.

Copperas or Ferrous Sulfate

The results of a large number of runs led to the following conclusions regarding copperas:

1. Optimum coagulation takes place at pH 9.0 or above.
2. Dosage required is 2.5 to 5.0 gpg.
3. Removals of SS are 80 per cent or better; of OC and BOD, 80 per cent.
4. Overdose causes after-precipitation with all its attendant evils, and may actually reduce removals.
5. Doses of permanganate improve coagulation.

Chlorinated Copperas

On the basis of the data obtained, the following conclusions regarding the treatment with chlorinated copperas are presented:

1. Chlorinated copperas will coagulate sewage approximately as well at pH 5.5 as at 9.5.
2. Approximately 10 to 15 gpg sulfuric acid or 12 to 17 gpg lime are needed to reach these values.
3. Correct dosage lies between 2.5 and 5.0 gpg chlorinated copperas.
4. Removals to be expected are 80 to 90 per cent of SS, 60 to 80 per cent of OC, and 70 to 80 per cent of BOD.
5. Small doses of potassium permanganate assist coagulation.

Calcium Chloride

The general conclusions to be drawn from the experiments in which calcium chloride was used are that:

1. Calcium chloride will coagulate sewage.
2. The reaction of the treated sewage must be decidedly alkaline.
3. A dosage of approximately 5 gpg is indicated.
4. Calcium chloride is best used to assist the coagulation of some other chemical such as ferric chloride.

Chlorinated alum and sodium aluminate were also tried and it was found that under the conditions at Dallas, neither was a suitable coagulant.

Protecting Bridge Structures from Moisture

The floor plates supporting the carriageways of certain old steel bridges in the Ruhr district have developed a marked sag, and frequent renewals of floor plates and other steelwork have been necessary on account of corrosion, either by percolating moisture or by fumes from locomotives. In the author's opinion the sagging is caused by the excessive rigidity of the concrete originally employed between the plates, girders and surfacing. Corrosion of the steelwork is promoted by the retention of water by the concrete; the cracking

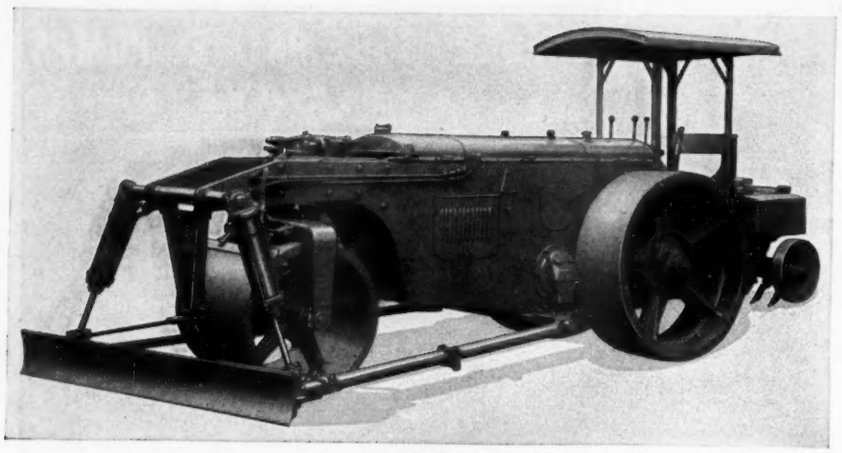
of the latter causes cracks to develop in the floated asphalt surfacing, the waterproof character of which is destroyed. A further cause of corrosive attack is the imperfect caulking of the rivets. Reconstruction of the carriageway with cement slabs embedded in mortar did not prove satisfactory. The footways, which had a 1¼-in. floated asphalt surfacing on a 3¼-in. tamped concrete foundation, developed cracks similar to those of the carriageway. The process of reconstruction which has been successfully used in several cases consists in: (a) The preliminary painting of the floorplates with a bituminous preparation, which can be applied direct without the use of a red-lead priming coat. (b) The caulking of the rivets with mastic, prepared from powdered calcareous rock asphalt, bitumen and fine hard stone chippings, and reinforced with steel wire mesh or preferably thin expanded metal. (c) The substitution for the concrete of a base course of hard stone chippings, which receive a bituminous penetration treatment. A 1¼-in. binder course of 0.12 to 0.32 in. chippings coated with a tar-bitumen mixture is laid on the base, and after two days a 1½-in. surfacing of coarse stone-filled asphalt is laid in two courses. (d) The steelwork of the footway is painted with an asphaltic preparation, and the broken vitrified brick formerly employed as base is replaced by whole bricks or by asphaltic paving slabs; expansion joints are provided in the floated asphalt surfacing at intervals of 50 ft.—*Bitumen*, 1935, 5 (9), 189-91.—*Road Abstracts.*

Filtration Plant Eliminates Need for Whisk Brooms

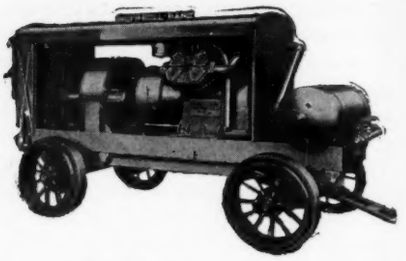
For the past twenty-seven years Montrose, Colo., has secured its summer supply of water from the Gunnison river, through the Gunnison Tunnel. The river, in addition to receiving the sewage discharge from the towns above Montrose, is almost continuously muddy from the summer rains on its water shed. Constant heavy dosages of chlorine prevented any serious effects from a health standpoint, but the settling basins used by the City were inadequate for clearing the water. Consequently the water in town was always muddy with an unpleasant taste as well as an obnoxious odor.

A filtration plant was completed and put into operation August 1, 1935. The total cost was $48,000.00, $13,000.00 of which was an outright grant from the Public Works Administration and the balance of the amount was furnished by the City. It is a rapid sand filter plant with four filter-beds of 500,000 gallons capacity each or a total daily capacity of 2,000,000 gallons. The capacity is ample to supply the city for many years to come unless a phenomenal growth in population should occur, in which case the plant is so constructed that additional filter beds could be installed without disarranging the present plant in any way. The plant was designed by and constructed under the supervision of Burton Lowther of Denver and ten months of operation has shown that the plant is a success in every way. It is interesting to note that at this time of the year, before the plant was constructed, twenty-four pounds of chlorine were required every twenty-four hours to obtain the residual required by the State Board of Health. At the present time five pounds provides the same residual. The water is clear and sparkling with no foreign taste or odor whatever and we are no longer ashamed to offer the stranger within our gates a drink of water; and towels now hang by the bath tubs instead of whisk brooms.—*From a report by Mayor R. R. Gowdy of Montrose before the Colorado Municipal League.*

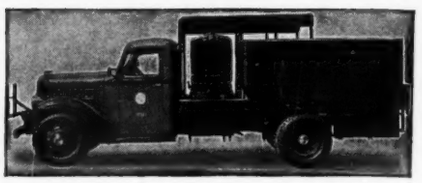
JAEGER "SURE PRIME" PUMPS
HAVE IT - -
• Fastest 100% Automatic Prime,
• Greater Efficiency at Any Lift,
• Thousands of Hours of Steady Service!
4" 3" 2"
6"
8"
10"
SIZES
7000 to 200,000 G. P. H.
New Catalog and Prices Will Tell You Why Jaeger Pumps Outsell All Others--Write for It.
THE JAEGER MACHINE CO.
400 Dublin Ave., Columbus, Ohio

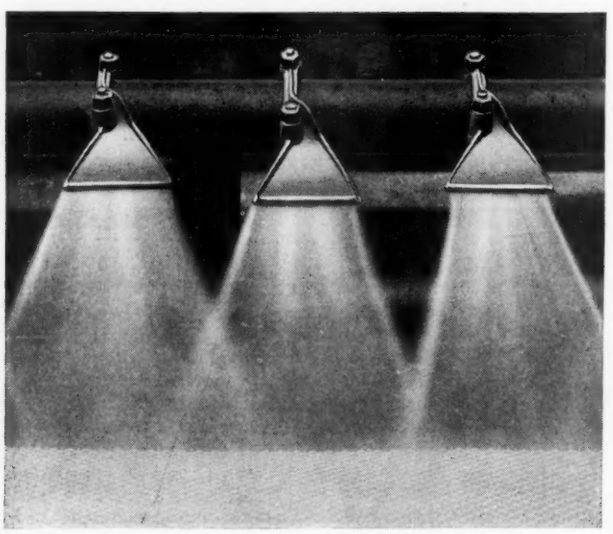


This is a new hydraulically controlled planer attachment that has been developed for use on 6-, 7- and 8-ton rollers. The 7-foot blade is designed to finish subgrades and to do other grading work where rolling is also required. Further data from Austin-Western Road Machinery Co., Aurora, Ill.

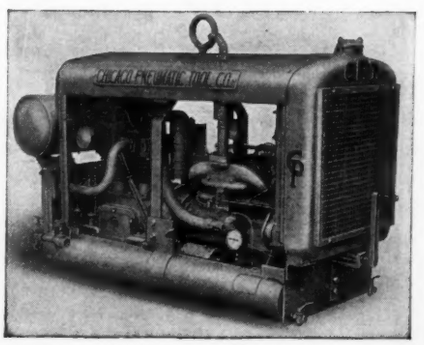


Ingersoll-Rand 2-stage electric portable compressor. Five models, 15 to 75 h.p. and numerous types of mountings. Described in Bulletin 2198. Ingersoll-Rand Co., 11 Broadway, N. Y.



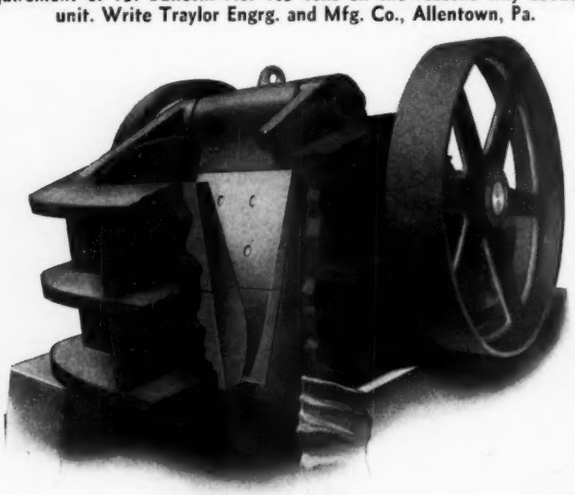


This is a spray nozzle, developed by Link-Belt Co., that is simple and effective for spraying, washing and cleaning all sorts of materials, screens, etc. Fairly large dirt particles will pass without clogging. Folder 1407 describes the nozzle and gives capacities in gallons per minute for different orifices for water pressures. Write Link-Belt Co., 300 W. Pershing Road, Chicago, Ill., or any branch office.



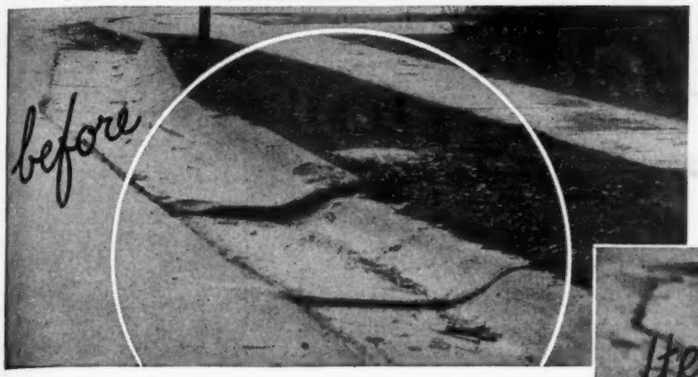
The lower illustration shows a new compressor of the Chicago Pneumatic Tool Co., 6 E. 44th St., N. Y., and the upper one shows it mounted on a specially designed truck body. This compressor is especially designed for public utility work; capacity 85 cu. ft. of free air a minute; discharge pressure 100 pounds; weight 1850 pounds. Ask for bulletin SP 1953.

Below: Traylor Type 4 Jaw Crusher. This is made in six sizes from 10 x 16 openings with a h. p. requirement of 15, up to 24 x 36 openings, with a h.p. requirement of 75. Bulletin No. 105 tells all the reasons why about this unit. Write Traylor Engrg. and Mfg. Co., Allentown, Pa.



Below: A Cletrac tractor shows a cheap, fast way of backfilling a trench or closing up an old channel.

MUD-JACK METHOD
for raising concrete curb · gutter · walks · street



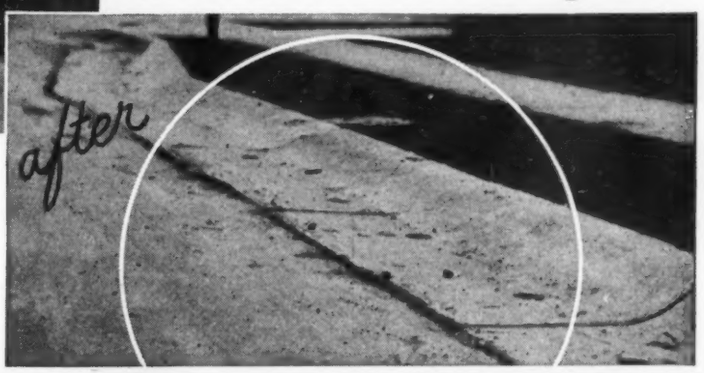
Sunken Curb and Gutter Marked for Reconstruction

but

THE MUD-JACK METHOD *corrected the settlement and saved the reconstruction costs*

Save CURB — GUTTER
WALKS — STREETS

The Mud-Jack method saves the slab —corrects the subgrade—eliminates pedestrian hazards. Write for data to reduce maintenance expense.



KOEHRING COMPANY

Pavers · Mixers · Shovels · Cranes
Draglines · Dumptors · Mud-Jacks
3026 WEST CONCORDIA AVE. MILWAUKEE, WISCONSIN

KOEHRING HEAVY DUTY

Illustrated is a brick resurface job on a concrete highway in Indiana. Similar resurface work has been done in Michigan, Ohio and Illinois. As the slabs became unserviceable, they were used as a base.

In brick resurface work the full salvage value of the old road is wisely retained. It is protected from further weather and traffic damage at a minimum expense. The public gets the modern, smooth-riding road that holds all records for length of life and freedom from maintenance expense.

Resurfacing with brick is sound engineering. Good results are a certainty. No expensive demolition—settled subgrades are left undisturbed. Widening is accomplished where desired at the same time.

As roads become worn, resurface with brick. Experience proves it is economically sound and highly satisfactory. Data on request from National Paving Brick Association, 1245 National Press Bldg., Washington, D. C.

BRICK...COSTS LESS PER YEAR

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 51-53.

PUBLIC WORKS NEWS

Asbestos Bonding is the title of a 12-page booklet issued by Armco Culvert Mfrs. Assn., Middletown, O. This bonding, though developed primarily for sewer service, is equally suitable for highway or other drainage work. It is said to increase the service life of the pipe. Copy on request.

* * *

Smootharc Welding Electrodes are designed to speed up welding operations with a smoother, more easily handled arc, and to reduce spatter losses. Various types and shapes. Ask for Bulletin R-1. Harnischfeger Corp., Milwaukee, Wis.

* * *

Vibrating Screens are illustrated and described in a bulletin just issued by Good Roads Machinery Corp., Kennett Square, Pa. Write J. W. Kitts and ask for Bulletin 5364.

* * *

Pipe Machines are described in a special Boulder Dam bulletin issued by Beaver Pipe Tools, Warren, O. These tools were used at the big dam. Lots of dope on a subject we do not know too much about. For a copy of this bulletin, write E. R. Barkley at the above address.

* * *

A 4-page bulletin describing a new design of non-clogging centrifugal pump of special design that develops high efficiencies and prevents slippage of pulpy material such as sewage, pulp, stock, etc., at high speeds; sectional views, rating tables and dimensions. Address Morris Machine Works, Baldwinsville, New York, and ask for Bulletin 160.

* * *

The Cochrane orifice meter is a simple and inexpensive instrument to measure the flow of liquids through pipe lines. Features include direct reading integrator, charts, interchangeable manometer tubes and other advantages. Records from 1 inch of water to 200 inches. Cochrane Corp., Philadelphia, Pa. Booklet 2092 sent on request.

* * *

Monarch Road Machinery Co., Grand Rapids, Mich., has a bulletin on their hydraulic scraper. This looks like the goods for fast patrol work in the elimination of ruts, bumps and that washboard corrugation that occurs in gravel roads. Full dope on request.

* * *

Hollow screws are described fully and complete specifications given in a catalog issued by The Allen Mfg. Co., Hartford, Conn.

* * *

Vibrators for placing and compacting concrete are described, and considerable information given on vibration of concrete, in a catalog issued by Master Vibrator Co., Dayton, O. Copy on request.

* * *

D. W. Haering & Co., Inc., 3408 W. Monroe St., Chicago, Ill., announce a twelve-page booklet on the principles and applications of liquid proportioning units employing the fluid piston principle. This booklet describes several types of proportioning units required for handling the various liquids utilized in the process industries. Sent free on request.

* * *

The Holophane Company, 342 Madison Avenue, New York, announce a new catalog on lighting facts called "Datalog"; 44 pages of illustrations and descriptions on the complete Holophane line for scientific lighting.

* * *

Roll-a-planes and road rollers are described and some excellent dope on rolling is given in a booklet on the subject just issued by Austin-Western Road Machinery Co., Aurora, Ill.

* * *

A condensed catalog—and a good one—describing Littleford equipment. Fits in your vest pocket and gives you condensed information on a lot of items you may find very worthwhile in your highway construction and maintenance work. For a copy write Larry Glaser, Littleford Bros., Cincinnati, O.

* * *

Concrete mixers, in all sizes from 3½S to the 27E paver, are described in four new catalogs just sent us by the Chain Belt Co., Milwaukee, Wis. One describes the 3½S and 5S mixers; another the 7S and 10S mixers; a third the 14S mixer; and the fourth the Rex 27E paver. Any or all sent on request.

* * *

Protective masks for workers where dusts are a hazard or an inconvenience are described in a bulletin published by Martindale Electric Co., 1378 Hird Ave., Cleveland, O. These are very light in weight, cheap and efficient. They offer no protection against vapors or gases.

* * *

New Offices:

Bryan & Sigmon Engineering Co., formerly of Loveland and Cincinnati, O., have opened an office in Newton Falls, O. They provide survey, report, design, construction and other services for utilities, water works, etc.

* * *

Charles Bruning Company, Inc., announces the establishment of a new branch at Kansas City, Mo., as an extension of its nation-wide service in sensitized papers, drawing materials, reproduction processes and drafting room equipment. Norman B. McKinnon will be manager.

New England Water Works Association

The 1936 convention of the New England Water Works Association will be held at the Pennsylvania Hotel, New York City, Sept. 22 to 25. The preliminary technical program has been announced by E. Sherman Chase, Statler Bldg., Boston, Mass., and the official program will be issued shortly.

Rocky Mountain Section A.W.W.A.

The Water Works College will be held under the auspices of the ninth annual meeting of the Rocky Mountain Section of the A.W.W.A. and the University of Colorado, Sept. 21-22. Papers and lectures on water treatment, well supplies, filter plants, sewage plants, modern equipment, etc., will make this an educational and informative meeting.

An inspection trip will be made to the Ralston Creek Dam and the million dollar Denver water filter plant which is now under construction.

Ben Howe, state sanitary engineer, Denver, Colo., is secretary-treasurer of the section.

Coming A.W.W.A. Section Meetings

October 12-15—Southwest Section—Hotel Goldman, Fort Smith, Ark. Secretary, Lewis A. Quigley, Supt., City Water Works, Fort Worth, Tex.

October 22-23—New York Section—Saratoga Springs, N. Y. Secretary, R. K. Blanchard, Neptune Meter Co., 50 W. 50th St., New York, N. Y.

October 23-24—New Jersey Section (jointly with the New Jersey Water Works Association and the South Jersey Association of Water Superintendents)—Hotel Ambassador, Atlantic City, N. J. Secretary, P. S. Wilson, 325 Washington St., Glen Ridge, N. J.

October 26-28—Missouri Valley Section—Hotel President, Kansas City, Mo. Secretary, E. L. Waterman, Prof. of Sanitary Engineering, University of Iowa, Iowa City, Ia.

October 26-28—North Carolina Section—Hotel Charlotte, Charlotte, N. C. Secretary, M. F. Trice, Asst. Engr., State Board of Health, Raleigh, N. C.

October 29-31—Virginia Section—Charlottesville, Va. Secretary, H. W. Snidow, Senior Asst. Engr., State Dept. of Health, 601 State Office Bldg., Richmond, Va.

November 6-7—Minnesota Section—Hotel West, Minneapolis, Minn. Secretary, R. M. Finch, Wallace & Tiernan Co., Inc., 414 Flour Exchange Bldg., Minneapolis, Minn.

Public Works Congress:

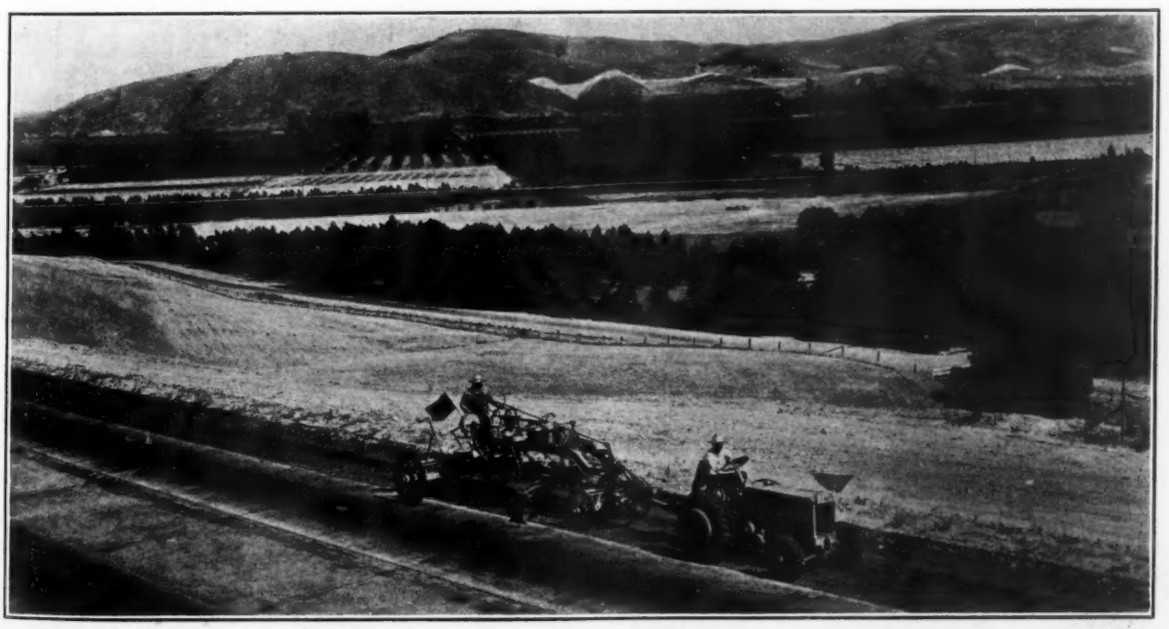
The 1936 Public Works Congress will be held at Toronto, Ont., September 28-30, with headquarters at the Royal York Hotel. This congress is under the joint auspices of the American Society of Municipal Engineers and the International Association of Public Works Officials. Frank W. Herring is executive director of the Congress, with headquarters at 850 East 58th St., Chicago, Ill.

NEWS AND PICTURES

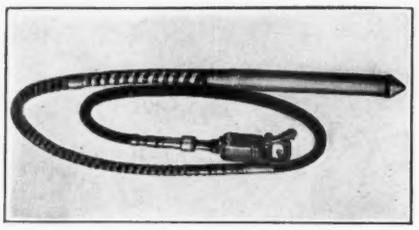
The Traylor TY reduction crusher is described very fully in Bulletin 112, issued by Traylor Engng. & Mfg. Co., Allentown, Pa. This unit is made in a variety of sizes and has many exclusive features.

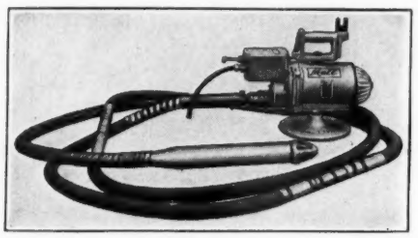
The new Mall floor grinder works equally well on hard and soft terrazzo marble; will not knock out chips. It grinds within 5/8 inch of the side wall. One grinding wheel will last a month of 8-hour working days. The manufacturers claim it will grind twice as much surface at half the cost. Write them for proof or for catalog 636 which describes this unit. Mall Tool Co., 7740 So. Chicago Ave., Chicago, Ill.

This is one of the new Allis-Chalmers tandem patrols, which are made in 42 and 54 horsepower. The former weighs 15,350 pounds; the latter 17,130 lbs. Speeds range from 2.3 to 10 m.p.h. An extra long wheel base; pneumatic tires in high or low pressure, and in 4 or 8-wheel tandem assemblies; and hydraulic brakes are among the features. Especially suited for oil-mix work and for ditching. Write Allis-Chalmers, Milwaukee, Wisc., for further dope.

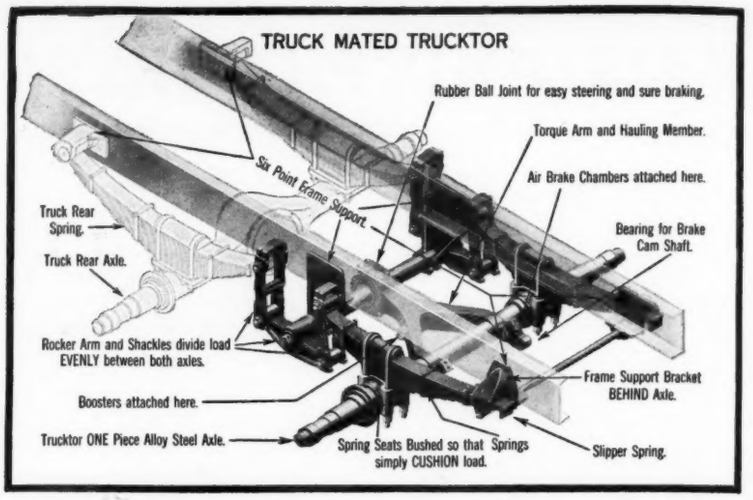


A Case C1 industrial tractor is doing its bit in pulling a Galion road grader in shoulder maintenance work on a concrete highway in California. This is but one of a large number of these units owned and operated by the California Highway Department.

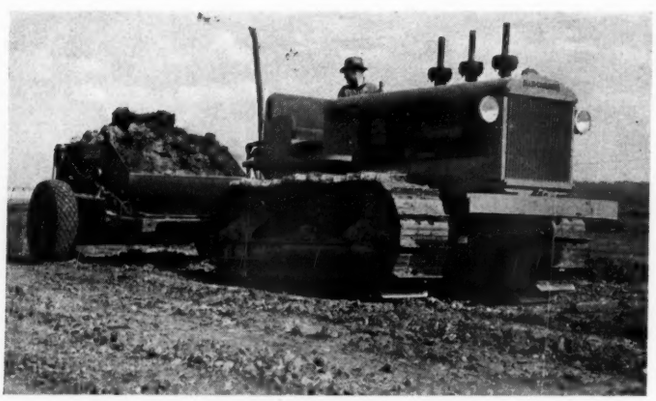




The Mall Tool Co., Chicago, announces two new concrete vibrator units, one operated by air and the other of the geared head type. Data and descriptions on these tools for placing better concrete will be sent if you write M. Rehnquist, at the above address.

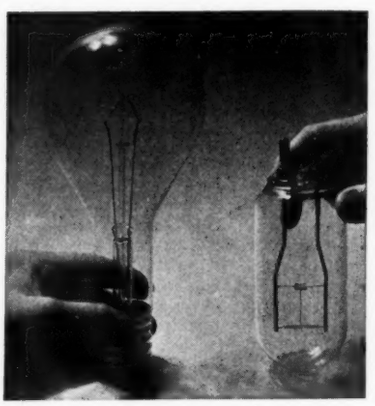

TRUCK MATED TRUCKTOR
Rubber Ball Joint for easy steering and sure braking.
Torque Arm and Hauling Member.
Six Point Frame Support
Air Brake Chambers attached here.
Truck Rear Spring.
Bearing for Brake Cam Shaft.
Truck Rear Axle.
Rocker Arm and Shackles divide load EVENLY between both axles.
Frame Support Bracket BEHIND Axle.
Boosters attached here.
Trucktor ONE Piece Alloy Steel Axle.
Spring Seats Bushed so that Springs simply CUSHION load.
Slipper Spring.

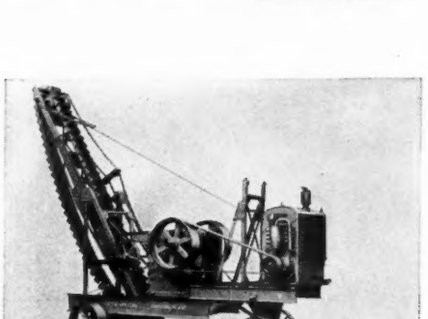
This illustration shows the anatomical arrangement of the Trucktor. This is a type of semi-trailer designed to operate as and with a 4-wheeled truck of lengthened frame and body. Adds capacity to your truck for hauling; weighs less than a trailer; performance data sent on request. Trucktor Corp., 156 Wilson Ave., Newark, N. J.

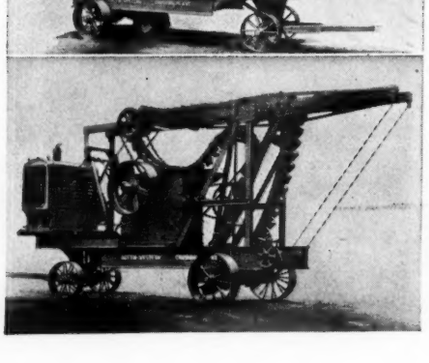


Allis-Chalmers announces new models KO and LO controlled ignition diesel fuel tractors. These operate on a variety of cheap diesel fuels and have given extraordinary performance results. KO develops 49 h.p.; LO, 79 h.p. Write Allis-Chalmers, Tractor Division, Milwaukee, Wisc., or visit nearest branch or dealer.

Right: New Westinghouse 4000 lumen, 6.6 ampere street series lamp, shown at the right, has a clear-glass bulb, a bi-post base, which incorporates prefocusing characteristics, and a horizontal filament that reduces glare. Made of pyrex glass, reducing danger of breakage from rain or snow. Existing design is also shown.

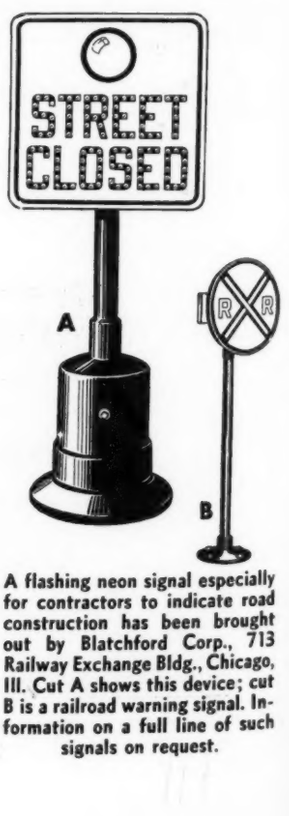






Left: A new line of small portable crushing plants, consisting of a crusher, a folding elevator and a motor, all mounted on a steel-tired truck, is announced by Austin-Western, Aurora, Ill. In 8 sizes especially for county, state and city conditions. Waukesha motors; V-belt drive. Full dope on request.

A new type of rule made by Lufkin Rule Co., Saginaw, Mich. Catalog of all types of measuring devices sent on request.



A flashing neon signal especially for contractors to indicate road construction has been brought out by Blatchford Corp., 713 Railway Exchange Bldg., Chicago, Ill. Cut A shows this device; cut B is a railroad warning signal. Information on a full line of such signals on request.

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 52

Cast Iron Sewers
385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe
386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Fire Hydrants
388. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

Gate Valves
390. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Glass Covers
393. Full details regarding the use of Lord & Burnham Glass-Overs at Middletown, N. Y.; Marion, Ohio; Cleveland, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Laboratory Equipment
400. The Phipps & Bird Stirrer, the solution feeder, a forthcoming stirrer using air for mixing, and all sorts of laboratory equipment for water and sewage plants. Bulletins and folders covering these pieces of equipment are complete and interesting. Phipps & Bird, Inc., 915 East Cary St., Richmond, Va.

Manhole Covers and Inlets
403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron
406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron
407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Concrete
408. Concrete Pipe Sewers, a 28-page booklet, contains much valuable information and numerous illustrations on concrete pipe. Issued by American Concrete Pipe Association, 33 West Grand Ave., Chicago.

Pipe Forms
409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints
410. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling, Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound
411. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control
412. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems
413. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Protective Pipe Coating
415. Coal-tar Pitch Enamels for exterior and interior linings for steel water lines; highly resistant to water absorption, soil acids and alkalis. Technical specifications for materials and their application will be sent on request. The Barrett Company, 40 Rector St., New York, N. Y.

Pumping Engines
417. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Rubber Lined Pipes and Pumps
418. New, 68-page catalog describes Ace rubber lined pipe and fittings, hard or soft rubber lined centrifugal pumps and Ace hard rubber double acting pumps, for chemicals used in treating sewage and water and for acids and other corrosive liquids. Contains illustrations and specifications. Issued by American Hard Rubber Co., 11 Mercer St., New York, N. Y.

Runoff & Stream-Flow
420. Technical information on measuring run-off, both from small areas, for storm sewer design, and from large areas for determining water-shed yield, and instruments for measuring. Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage
421. The simple, automatic Loughlin, self-cleaning travelling screen is fully described in an interesting bulletin issued by Filtration Equipment Co., 10 East 40th St., New York, N. Y.

423. Sewage screens (Tark, Brunotte and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia, Pa. Books 1294, 1542 and 1587.

Rainfall Measurement
429. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens
430. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sludge Bed Glass Covers
432. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Elizabeth, N. J. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Incineration
438. A multiple hearth furnace which meets the most exacting municipal sanitary requirements for the incineration of sewage sludge—produces a fine ash or partially dry sludge for fertilizer—is described and illustrated with drawings and photographs in bulletins issued by Nichols Engineering and Research Corp., 40 Wall St., New York, N. Y. Operation as well as installation data is given.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Sludge Removal Equipment
442. If you are interested in economical sludge removal, write for the latest bulletin describing and illustrating Louden Monorail equipment which is adapted to open or closed beds. Full details sent promptly by the Louden Machinery Co., 400 West Ave., Fairfield, Iowa.

Swimming Pool Equipment
444. Filters, chlorination, underwater lights and other supplies for swimming pools are very thoroughly described in literature and folders. Plans and layouts. Everson Filter Co., 625 W. Lake St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment
448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

449. Installation views and considerable engineering data including capacity tables for settling tanks and layouts of typical arrangements for both final and primary tanks, are contained in a new booklet—No. 1542—just published for engineers by Link-Belt Company, 307 No. Michigan Ave., Chicago, Ill.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

452. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

453. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill., and Philadelphia.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 247 Park Ave., New York, N. Y.

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Concrete Curing:

The use of calcium chloride in concrete curing and pretty complete dope, specifications and tables are briefed in a 4-page folder that has just been issued by the Calcium Chloride Association, Penobscot Bldg., Detroit, Mich. This folder will be sent on request.

Safety for Swimming Pools:

A neat little folder with specific information on chlorination of swimming pool waters. Also gives directions for chlorination of small pools without a chlorinator. Other data cover the chloramine treatment, using ammonia with chlorine; prevention of athlete's foot; deodorizing and disinfecting; and the prevention of slime and algae growth. A non-technical little booklet with plenty of good information. For a copy write Pennsylvania Salt Mfg. Co., Widener Bldg., Philadelphia, Pa.

Asphalt Surfaces:

The Asphalt Institute has prepared the following specifications which will be sent on request to them at 801 Second Ave., N. Y.: Patching, reducing crown and correcting profile, Specification B-6, 7 pages. Asphalt surface treatment of waterbound surfaces, Specification S-2, 8 pages. Asphalt surface treatment of loosely bonded surfaces, Specification S-3, 7 pages. These may be used in contract work or as a guide in force account work. S-2 applies also to clay-gravel, sand-clay, and limerock, and S-3 to traffic bonded macadam, sandy gravel and cinders.

Wind News:

Another of those beautiful and excellent publications of Julian P. Friez & Sons, Inc., Baltimore, Md. This one tells about and illustrates the various types of weather instruments and also includes a chart for foretelling the weather from wind directions and barometer actions. Sent on request.

Water, Snow and Air Instruments:

A 16-page book of standard instruments for weather, water resources, upper air explorations, air conditioning surveys and soil conservation projects. Sent on request to Julien P. Friez & Sons, Inc., Baltimore, Md.

Segment Block Sewers:

Really complete information on segment block sewers. Advantages, costs, amount of excavation necessary for these sewers, weights and dimensions of blocks, construction data, inspection of construction, strength, manhole construction, making connections, curves, suggested method of laying with detail information, loading tests, and other data. 44 pages. Sent on request to Robinson Clay Products Co., Akron, O., and Empire State Bldg., New York City.

House Plumbing Hydraulics:

This is an exhaustive report on the hydraulics of water closet bowls and flushing devices; it is the result of a cooperative project of the Massachusetts Association of Master Plumbers and the Civil and Sanitary Engineering Departments of M. I T. There are 126 pages and 65 illustrations. There are so many data, so closely packed into the report that any abstract or review is out of the question in this limited space; but to those who are interested, we might say that they will find most everything they wish to know. No price stated; perhaps a letter to Prof. T. R. Camp, Professor of Sanitary Engineering, M. I. T., Boston, Mass., would bring a copy.

Salt Stabilized Roads:

The Highway Research Board has presented an excellent report on treating stabilized soil roads with sodium chloride, or common salt. Subjects treated include: General principles; design features; the soil binder; the salt; action of water; crown; construction features; mixing methods; placing material; compacting; field checking, sampling and testing; and maintenance. There are 24 pages and several illustrations. We believe that copies can be obtained from Dr. Looker, International Salt Co., Ithaca, N. Y.

Corrosion Resistance:

This is a 492-page treatise on the corrosion resistance of metals and alloys, by Robert J. McKay and Robert Worthington. It is published by the Reinhold Publishing Co., N. Y., as a monograph of the American Chemical Society, and sells for $7.

Paving Equipment:

A 60-page publication, which is altogether too fine and instructive to list as a catalog. It is better described by its subtitle, "A pictorial review of modern road building." Covers forms, grading and finishing equipment, bituminous pavers, spreader boxes, and lots of other equipment. Sent on request to Jaeger Machine Co., Columbus, O. Ask for catalog PM 36.

Wrought Iron and Steel Pipe:

"American Tentative Standards on Wrought Iron and Wrought Steel Pipe" has been published by the American Standards Association, 29 West 39th St., New York. Copies are available at 50 cents each.

Rotovalves:

A folder describes Morgan Smith rotovalves for water, sewage, gas, air and oil work, for relief, check, regulating, float and blow-off and other work. Made in sizes from 6- to 48-inch as standard equipment, and in special sizes from 54-inch up. Write S. Morgan Smith Co., York, Pa., for a copy.

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